QUARTERLY REPORT NO. 6

(DECEMBER 1, 1975 TO FEBRUARY 29, 1976)

ENVIRONMENTAL BASELINE DATA COLLECTION

AND

MONITORING PROGRAM

FEDERAL PROTOTYPE OIL SHALE

LEASING PROGRAM

TRACTS U-a and U-b

UTAH

WHITE RIVER SHALE PROJECT

vtn

TN

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The attached report is the sixth of a planned series of reports from the Federal Oil Shale Lessees to the Area Oil Shale Supervisor describing progress under approved exploration and baseline data plans.

The purpose of these reports is to provide interested parties with a review of ongoing operations and a summary of the data being collected. Because of the sheer volume of data being generated, these reports should be considered as the first (overview) phase of planned data distribution. Parties interested in reviewing more detailed data on specific portions of the program should contact the Area Oil Shale Office in Grand Junction where such data will be kept on file.

We would appreciate receiving any comments or suggestions you may have concerning these reports.

Peter A. Rutledge

PETER A. RUTLEDGE
AREA OIL SHALE SUPERVISOR

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I. INTRODUCTION

This document is a summary of work conducted from December 1, 1975, to February 29, 1976, as part of the environmental baseline monitoring program for Tracts U-a and U-b. The baseline program is being conducted in accordance with the Partial Exploration Plan, Environmental Baseline Data Collection and Monitoring Element, submitted July 1, 1974, and the Conditions of Approval developed by the Area Oil Shale Supervisor (AOSS) for various sub-elements of the program. As requested by the AOSS, the field data collected for this quarter have also been submitted and are on file in the AOSS office in Grand Junction, Colorado.

This report interprets and analyzes data that will be incorporated within the First Year Environmental Baseline Report (FYEBR), which covers the period from the beginning of each baseline monitoring program element to January 15, 1976, or a period of not less than one year.

II. WATER RESOURCES

A. WORK COMPLETED

1. SURFACE WATER

The surface water monitoring program was modified during the sixth quarter because of the completion of the first year of baseline data and because of AOSS requests. The following actions were taken to comply with the AOSS letter of January 26, 1976, entitled "Revisions to the Conditions of Approval."

1. Three stream-gaging stations--S-7, S-8, and S-15--were deleted

2. Three stream-gaging stations--S-1, S-4 and S-5--were deactivated for the winter or ice period

3. The flow-measurement and sediment schedules were changed

4. A continuous suspended-sediment sampler was installed at Station S-11. This unit will be set initially to collect four samples a day

All stream-gaging stations were inspected for safety, the quality of data collection, and hydrologic readiness. Many details were updated.

Because of an early snowmelt all but one of the intermittent streams had sufficient flow for recording discharge measurements and sediment and water quality samples.

2. SURFACE WATER QUALITY

The surface water quality monitoring program was modified as specified in the AOSS letter of January 26, 1976. The frequency of the surface water quality monitoring was reduced from twice a month to once a month, and certain constituents were added or deleted. The installation of additional precipitation equipment for water quality sampling was completed and samples were taken. Some duplicate surface water samples were taken as quality-control measures.

3. GROUND WATER LEVEL MONITORING

Static water-level measurements were made in all wells in the first week of December, January, and February, and continuous water-level monitoring was conducted at P-1, P-2 upper, P-2 lower, and P-3.

4. GROUND WATER QUALITY

Samples were collected in January from nine new alluvial wells completed the same month. The new wells are distributed along the White River (6), Asphalt Wash (2), Southam Canyon (2), and Evacuation Creek (2). The wells were installed as directed by the AOSS.

B. DATA SUMMARY

1. SURFACE WATER

a. Streamflow

White River

During the sixth quarter, ice on the river prevented stage measurements, from which streamflows are calculated. Without these measurements the USGS must develop the data by a more time-consuming method. The data have not been developed at this time.

Evacuation Creek

The USGS is still processing the streamflow data for Evacuation Creek.

Hells Hole Canyon, Southam Canyon, and Asphalt Wash

The USGS is still processing the streamflow data for the three washes.

b. Precipitation and Evaporation

From October 1975 through February 1976 precipitation was about 50 percent higher than for the same period in the preceding year--9.9 cm (3.9 in.) versus 6.7 cm (2.7 in.) Evaporation measurements have been discontinued during winter because water freezes in the pans.

2. SURFACE WATER QUALITY

a. White River

Tables II-1 through II-4 are similar to the summaries in the fourth and fifth quarterly reports for the White River from August 1975 through January 1976. (February results are being reviewed.) Concentrations of major ions were generally slightly below those of the baseflow period during the first year, but concentrations of trace elements were generally about the same as in the first year. (The means were usually within one standard deviation of each other.) There are no outstanding differences between first-year data and second-year data. If trends found in the first year recur, the lower major ion concentrations in the first part of the second year will probably be balanced by higher concentrations in the latter part of the second-year baseflow period.

The preliminary data for streambed mineralogy is summarized on Table II-5. The results of the coliform and BOD tests for the quarter are shown on Table II-6.

b. Evacuation Creek

The water-quality samples from Evacuation Creek (see Tables II-7 and II-8) were much the same as those taken during the first year; that is, major-ion concentrations were lower than last year, but trace-element concentrations were about the same. Only copper concentrations showed sizeable increases.

As in the first-year baseflow records, constituent concentrations were generally higher at Station S-6 than downstream at Station S-2. Since Evacuation Creek and the bird's nest aquifer are in contact in this reach, the higher concentrations probably relate to flow and quality modifications caused by the aquifer.

TABLE II-1

SUMMARY OF SURFACE WATER QUALITY
WHITE RIVER ABV. HELLS HOLE CYN. NR. WATSON (S-1)
BASE FLOW - AUG. 5, 1975 - OCT. 21, 1975

scription	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
mperature (°C)	5	15.8	6.3	21.0	6.5
rbidity (JTU)	5	25.	25.	54.	1.
nductance (µmhos)	5	719.	36.	762.	675.
emical Oxygen Demand (mg/1)	5	12.	5.	17.	5.
(pH Units)	4	8.5	0.1	8.6	8.4
rbon Dioxide (mg/1)	4	1.2	0.3	1.5	0.9
kalinity (mg/1 $CACO_3$)	5	178.	19.	194.	147.
carbonate (mg/1 HCO_3)	5	214.	23.	235.	175.
rbonate (mg/1 CO_3)	5	2.	3.	7.	0.
lterable Residue (mg/1)	1	560.	-------	560.	-------
1 & Grease (mg/1)	5	0.	0.	0.	0.
monia (mg/1 N)*	5	0.00	0.00	0.00	0.00
trite (mg/1 N)*	5	0.002	0.004	0.01	0.00
trate (mg/1 N)*	5	0.17	0.27	0.65	0.00
eldahl Nitrogen (mg/1 N)	5	0.43	0.17	0.67	0.21
2 + NO_3 (mg/1 N)*	5	0.17	0.28	0.66	0.00
thophosphate (mg/1 PO_4)*	5	0.02	0.04	0.09	0.00
osphorus (mg/1)	5	0.07	0.08	0.22	0.03
thophosphorus (mg/1 P)*	5	0.01	0.01	0.03	0.00
tal Organic Carbon (mg/1)	1	3.6	-------	3.6	-------
tal Inorganic Carbon (mg/1)	0	-------	-------	-------	-------
anide (mg/1)	3	0.00	0.00	0.00	0.00
lfide (mg/1)*	5	0.2	0.2	0.5	0.0
rdness (mg/1 Ca, Mg)	5	304.	105.	490.	240.
n Carbonate Hardness (mg/1)	5	111.	106.	290.	80.
lcium (mg/1)*	5	69.	13.	91.	66.
gnesium (mg/1)*	5	32.	17.	63.	22.
dium (mg/1)*	5	92.	78.	230.	50.
dium Adsorption Ratio	5	2.2	1.3	4.5	1.4
Sodium	5	36.	8.	50.	30.
tassium (mg/1)*	5	2.4	1.0	4.1	1.6
loride (mg/1)*	5	31.	4.	37.	25.
lfate (mg/1)*	5	160.	20.	190.	140.
uoride (mg/1)*	5	0.3	0.1	0.4	0.2
lica (mg/1)*	5	11.6	2.3	15.0	8.8
senic (mg/1)*	3	0.002	0.001	0.002	0.001
rium (mg/1)*	3	0.147	0.050	0.200	0.100
ryllium (mg/1)*	2	<0.0005	-------	<0.0010	0.0000
smuth (mg/1)*	2	<0.004	-------	<0.006	<0.003
ron (mg/1)*	3	0.062	0.018	0.080	0.045
dium (mg/1)*	3	0.000	0.000	0.000	0.000
romium (mg/1)*	3	0.006	0.005	0.010	0.000
balt (mg/1)*	3	<0.001		<0.002	0.000
pper (mg/1)*	3	0.003	0.002	0.005	0.001
on (mg/1)*	2	0.000	0.000	0.000	0.000
ad (mg/1)*	3	0.001	0.002	0.004	0.000
nganese (mg/1)*	2	0.005	0.007	0.010	0.000
rcury (mg/1)*	3	0.0001	0.0001	0.0002	0.0000
lybdenum (mg/1)*	3	0.004	0.002	0.006	0.002
ckel (mg/1)*	3	0.005	0.006	0.012	0.001
lver (mg/1)*	2	0.000	0.000	0.000	0.000
rontium (mg/1)*	2	0.750	0.099	0.820	0.680
nadium (mg/1)*	3	0.0045	0.0047	0.0100	0.0015
nc (mg/1)*	3	0.013	0.015	0.030	0.000
n (mg/1)*	2	<0.005	-------	<0.006	<0.004
uminum (mg/1)*	2	0.025	0.021	0.040	0.010
llium (mg/1)*	2	<0.002	0.000	<0.002	<0.002
rmanium (mg/1)*	2	<0.005	-------	<0.006	<0.004
thium (mg/1)*	3	0.013	0.006	0.020	0.010
lenium (mg/1)*	3	0.001	0.001	0.001	0.000
tanium (mg/1)*	1	<0.002	-------	<0.002	-------
rconium (mg/1)*	1	<0.005	-------	<0.005	-------
oss Beta (pc/1, Cs-137)*	1	4.7	-------	4.7	-------
lorophyll A (mg/1)	3	0.0013	0.0003	0.0015	0.0009
lorophyll B (mg/1)	3	0.0012	0.0004	0.0015	0.0008
enols (mg/1)	5	0.003	0.002	0.005	0.001
ssolved Solids (mg/1)*	4	468.	33.	517.	452.
oss Alpha (mg/1 U)*	1	0.014	-------	0.014	-------
oss Beta (pc/1, SR_{90}/Y_{90})*	1	3.5	-------	3.5	-------
omide (mg/1)	5	0.1	0.04	0.1	0.0

Elements analyzed for dissolved fraction

TABLE II-2

SUMMARY OF SURFACE WATER QUALITY
WHITE RIVER NEAR WATSON (S-3)
BASE FLOW - AUG. 4, 1975 - JAN. 5, 1976

Description	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
Temperature (°C)	9	11.1	8.1	21.0	0.0
Turbidity (JTU)	8	28.	26.	76.	1.
Conductance (µmhos)	9	743.	112.	996.	625.
Chemical Oxygen Demand (mg/l)	8	10.	7.	21.	1.
pH (pH units)	8	8.3	0.3	8.8	8.0
Carbon Dioxide (mg/l)	8	2.1	1.3	4.0	0.6
Alkalinity (mg/l $CaCO_3$)	9	188.	11.	205.	174.
Bicarbonate (mg/l HCO_3)	9	228.	13.	250.	212.
Carbonate (mg/l CO_3)	9	1.	2.	6.	0.
Filterable Residue (mg/l)	3	513.	32.	550.	490.
Oil & Grease (mg/l)	8	0.3	0.5	1.	0.
Ammonia (mg/l N)*	8	0.01	0.01	0.04	0.00
Nitrite (mg/l N)*	8	0.001	0.004	0.01	0.00
Nitrate (mg/l N)*	8	0.10	0.14	0.35	0.00
Kjeldahl Nitrogen (mg/l N)	8	0.50	0.22	0.86	0.25
NO_2 + NO_3 (mg/l N)*	9	0.09	0.13	0.35	0.00
Orthophosphate (mg/l PO_4)*	9	0.02	0.02	0.06	0.00
Phosphorus (mg/l)	8	0.07	0.08	0.23	0.00
Orthophosphorus (mg/l P)*	9	0.01	0.01	0.02	0.00
Total Organic Carbon (mg/l)	2	3.2	0.1	3.3	3.1
Total Inorganic Carbon (mg/l)	1	53.	-------	53.	-------
Cyanide (mg/l)	6	0.00	0.00	0.00	0.00
Sulfide (mg/l)*	8	0.3	0.7	1.9	0.0
Hardness (mg/l Ca, Mg)	9	273.	15.	300.	250.
Non Carbonate Hardness (mg/l)	9	84.	70.	96.	74.
Calcium (mg/l)*	9	67.	5.	79.	60.
Magnesium (mg/l)*	9	25.	2.	29.	23.
Sodium (mg/l)*	9	60.	6.	70.	52.
Sodium Adsorption Ratio	9	1.6	0.2	1.9	1.4
% Sodium	9	32.	2.	36.	30.
Potassium (mg/l)*	9	2.0	0.3	2.5	1.7
Chloride (mg/l)*	9	32.	4.	39.	25.
Sulfate (mg/l)*	9	163.	12.	180.	150.
Fluoride (mg/l)*	9	0.3	0.0	0.3	0.2
Silica (mg/l)*	9	12.5	2.2	15.0	8.9
Arsenic (mg/l)*	6	0.001	0.001	0.001	0.000
Barium (mg/l)*	6	<0.116	-------	0.200	0.000
Beryllium (mg/l)*	2	0.000	0.000	0.000	0.000
Bismuth (mg/l)*	1	<0.003	-------	<0.003	-------
Boron (mg/l)*	7	0.066	0.015	0.090	0.050
Cadmium (mg/l)*	6	0.000	0.0004	0.001	0.000
Chromium (mg/l)*	6	<0.006	-------	0.010	0.000
Cobalt (mg/l)*	6	0.001	0.001	0.001	0.000
Copper (mg/l)*	6	0.004	0.003	0.009	0.001
Iron (mg/l)*	6	0.033	0.059	0.150	0.000
Lead (mg/l)*	6	0.0002	0.0004	0.001	0.000
Manganese (mg/l)*	6	0.004	0.005	0.010	0.000
Mercury (mg/l)*	6	0.00003	0.00005	0.0001	0.0000
Molybdenum (mg/l)*	6	0.003	0.001	0.004	0.002
Nickel (mg/l)*	6	0.003	0.002	0.005	0.000
Silver (mg/l)*	2	0.000	0.000	0.000	0.000
Strontium (mg/l)*	2	0.925	0.077	0.980	0.870
Vanadium (mg/l)*	6	0.0021	0.0005	0.0027	0.0014
Zinc (mg/l)*	6	0.007	0.008	0.020	0.000
Tin (mg/l)*	1	<0.003	-------	<0.003	-------
Aluminum (mg/l)*	6	0.022	0.013	0.040	0.000
Gallium (mg/l)*	1	<0.002	-------	<0.002	-------
Germanium (mg/l)*	1	<0.007	-------	<0.007	-------
Lithium (mg/l)*	6	0.012	0.004	0.020	0.010
Selenium (mg/l)*	6	0.001	0.000	0.001	0.001
Titanium (mg/l)*	1	<0.002	-------	<0.002	-------
Zirconium (mg/l)*	1	<0.005	-------	<0.005	-------
Gross Beta (Pc/l, Cs-137)*	3	2.8	1.1	4.1	1.9
Chlorophyll A (mg/l)	6	0.0012	0.0006	0.0018	0.0004
Chlorophyll B (mg/l)	6	0.0009	0.0012	0.0031	0.0000
Phenols (mg/l)	8	0.005	0.003	0.011	0.002
Dissolved Solids (mg/l)*	8	489.	28.	533.	456.
Gross Alpha (mg/l U)*	3	<0.0084	-------	0.0094	<0.0069
Gross Beta (Pc/l, Sr_{90}/Y_{90})*	3	2.3	0.8	3.2	1.6
Bromide (mg/l)	8	0.1	0.04	0.1	0.0

* Elements analyzed for dissolved fraction

TABLE II-3

SUMMARY OF WATER QUALITY
WHITE RIVER ABV. SOUTHAM CAN. NEAR WATSON (S-4)
BASE FLOW - AUG. 6, 1975 - DEC. 1, 1975

Description	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
Temperature (°C)	6	12.9	8.5	22.0	0.5
Turbidity (JTU)	6	27.	20.	60.	2.
Conductance (μmhos)	6	737.	29.	780.	700.
Chemical Oxygen Demand (mg/1)	6	10.	5.	17.	2.
pH (pH Units)	4	8.3	0.4	8.7	7.7
Carbon Dioxide (mg/1)	4	3.1	3.2	7.8	0.7
Alkalinity (mg/1 $CACO_3$)	6	189.	10.	199.	178.
Bicarbonate (mg/1 HCO_3)	6	229.	13.	243.	210.
Carbonate (mg/1 CO_3)	5	0.6	0.9	2.0	0.0
Filterable Residue (mg/1)	2	590.	141.	690.	490.
Oil & Grease (mg/1)	6	0.2	0.4	1.	0.
Ammonia (mg/1 N)*	6	0.01	0.02	0.04	0.00
Nitrite (mg/1 N)*	6	0.003	0.005	0.01	0.00
Nitrate (mg/1 N)*	6	0.04	0.08	0.20	0.00
Kjeldahl Nitrogen (mg/1 N)	6	0.48	0.31	1.10	0.25
NO_2 + NO_3 (mg/1 N)*	6	0.05	0.08	0.21	0.00
Orthoposphate (mg/1 PO_4)*	6	0.02	0.03	0.06	0.00
Phosphorus (mg/1)	6	0.11	0.18	0.47	0.02
Orthoposphorus (mg/1 P)*	6	0.01	0.01	0.02	0.00
Total Organic Carbon (mg/1)	1	7.3		7.3	
Total Inorganic Carbon (mg/1)	0	-------	-------	-------	-------
Cyanide (mg/1)	4	0.00	0.00	0.00	0.00
Sulfide (mg/1)*	6	0.4	0.8	2.0	0.0
Hardness (mg/1 Ca, Mg)	6	270.	11.	280.	260.
Non Carbonate Hardness (mg/1)	6	80.	6.	84.	68.
Calcium (mg/1)*	6	66.	4.	73.	62.
Magnesium (mg/1)*	6	26.	3.	30.	23.
Sodium (mg/1)*	6	60.	8.	74.	52.
Sodium Adsorption Ratio	6	1.6	0.2	1.9	1.4
% Sodium	6	32.	3.	37.	30.
Potassium (mg/1)*	6	2.0	0.4	2.4	1.6
Chloride (mg/1)*	6	32.	4.	37.	26.
Sulfate (mg/1)*	6	162.	19.	190.	140.
Fluoride (mg/1)*	6	0.3	0.0	0.3	0.2
Silica (mg/1)*	6	12.1	2.4	15.0	8.4
Arsenic (mg/1)*	4	0.0005	0.0006	0.0010	0.0000
Barium (mg/1)*	4	<0.125	<0.050	<0.200	<0.100
Beryllium (mg/1)*	1	0.000		0.000	
Bismuth (mg/1)*	1	<0.003		<0.003	
Boron (mg/1)*	4	0.088	0.013	0.100	0.070
Cadmium (mg/1)*	4	0.0003	0.0005	0.001	0.000
Chromium (mg/1)*	4	<0.005	<0.006	0.010	0.000
Cobalt (mg/1)*	4	0.000	0.000	0.000	0.000
Copper (mg/1)*	4	0.003	0.001	0.003	0.002
Iron (mg/1)*	4	0.003	0.005	0.010	0.000
Lead (mg/1)*	4	0.002	0.002	0.005	0.000
Manganese (mg/1)*	4	0.003	0.005	0.010	0.000
Mercury (mg/1)*	4	0.0001	0.0001	0.0002	0.0000
Molybdenum (mg/1)*	4	0.003	0.001	0.004	0.002
Nickel (mg/1)*	4	0.004	0.002	0.006	0.002
Silver (mg/1)*	1	0.000		0.000	
Strontium (mg/1)*	1	0.820		0.820	
Vanadium (mg/1)*	4	0.0019	0.0003	0.0022	0.0015
Zinc (mg/1)*	4	0.008	0.005	0.010	0.000
Tin (mg/1)*	1	<0.003	0.000	<0.003	<0.003
Aluminum (mg/1)*	4	0.020	0.008	0.030	0.010
Gallium (mg/1)*	1	<0.002		<0.002	
Germanium (mg/1)*	1	<0.007		<0.007	
Lithium (mg/1)*	4	0.008	<0.005	0.010	0.000
Selenium (mg/1)*	4	0.001	0.000	0.001	0.001
Titanium (mg/1)*	1	<0.002		<0.002	
Zirconium (mg/1)*	1	<0.005		<0.005	
Gross Beta (pc/1, Cs-137)*	2	8.3	6.7	13.0	3.6
Chlorophyll A (mg/1)	2	0.0050	0.0054	0.0088	0.0012
Chlorophyll B (mg/1)	2	0.0080	0.0099	0.0150	0.0009
Phenols (mg/1)	6	0.002	0.002	0.005	0.001
Dissolved Solids (mg/1)*	6	485.	25.	522.	459.
Gross Alpha (mg/1 U)*	2	0.0117	0.0075	0.0170	0.0064
Gross Beta (pc/1, SR_{90}/Y_{90})*	2	6.4	5.1	10.0	2.8
Bromide (mg/1)	6	0.11	0.04	0.1	0.0

* Elements analyzed for dissolved fraction

TABLE II-4

SUMMARY OF SURFACE WATER QUALITY
WHITE RIVER BLW. ASPH. WASH NR. WATSON (S-11)
BASE FLOW - AUG. 7, 1975 - Jan. 7, 1976

Description	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
Temperature (°C)	7	9.3	8.5	21.0	0.5
Turbidity (JTU)	8	41.	47.	150.	8.
Conductance (umhos)	7	748.	42.	825.	704.
Chemical Oxygen Demand (mg/l)	8	10.	6.	15.	1.
pH (pH units)	6	8.2	0.3	8.5	7.8
Carbon Dioxide (mg/l)	6	2.9	1.9	6.0	1.1
Alkalinity (mg/l $CACO_3$)	8	190.	14.	216.	176.
Bicarbonate (mg/l HCO_3)	8	232.	17.	263.	211.
Carbonate (mg/l CO_3)	7	0.3	0.8	2.0	0.0
Filterable Residue (mg/l)	2	530.	14.	540.	520.
Oil & Grease (mg/l)	8	0.4	0.7	2.0	0.0
Ammonia (mg/l N)*	8	0.02	0.02	0.05	0.00
Nitrite (mg/l N)*	8	0.01	0.01	0.01	0.00
Nitrate (mg/l N)*	8	0.07	0.09	0.27	0.00
Kjeldahl Nitrogen (mg/l N)	8	0.45	0.28	1.10	0.24
NO_2 + NO_3 (mg/l N)*	8	0.07	0.09	0.27	0.00
Orthophosphate (mg/l PO_4)	8	0.02	0.03	0.09	0.00
Phosphorus (mg/l)	8	0.09	0.11	0.36	0.00
Orthophosphorus (mg/l P)*	8	0.01	0.01	0.03	0.00
Total Organic Carbon (mg/l)	2	4.4	2.3	6.0	2.8
Total Inorganic Carbon (mg/l)	1	57.	-	57.	-
Cyanide (mg/l)	6	0.00	0.00	0.00	0.00
Sulfide (mg/l)*	8	0.1	0.1	0.2	0.0
Hardness (mg/l Ca, Mg)	8	275.	19.	310.	250.
Non Carbonate Hardness (mg/l)	8	85.	8.	95.	77.
Calcium (mg/l)*	8	68.	6.	81.	61.
Magnesium (mg/l)*	8	26.	2.	30.	23.
Sodium (mg/l)*	8	62.	6.	69.	55.
Sodium Adsorption Ratio	8	1.6	0.1	1.8	1.5
% Sodium	8	33.	2.	36.	30.
Potassium (mg/l)*	8	2.0	0.3	2.3	1.6
Chloride (mg/l)*	8	34.	5.	43.	27.
Sulfate (mg/l)*	8	166.	13.	180.	150.
Fluoride (mg/l)*	8	0.28	0.05	0.30	0.20
Silica (mg/l)*	8	12	2.	15.	10.
Arsenic (mg/l)*	6	0.001	0.001	0.002	0.000
Barium (mg/l)*	6	<0.140	<0.102	0.300	0.000
Beryllium (mg/l)*	3	<0.0003	<0.0006	<0.0010	0.0000
Bismuth (mg/l)*	2	<0.005	<0.002	<0.006	<0.003
Boron (mg/l)*	6	0.075	0.005	0.080	0.070
Cadmium (mg/l)*	6	0.0002	0.0004	0.0010	0.0000
Chromium (mg/l)*	6	<0.0005	<0.0005	0.0010	0.0000
Cobalt (mg/l)*	6	<0.0005	<0.0008	<0.0020	0.0000
Copper (mg/l)*	6	0.004	0.005	0.013	0.001
Iron (mg/l)*	6	0.595	1.423	3.500	0.000
Lead (mg/l)*	6	0.001	0.002	0.005	0.000
Manganese (mg/l)*	6	0.004	0.005	0.010	0.000
Mercury (mg/l)*	6	0.00002	0.00004	0.00010	0.00000
Molybdenum (mg/l)*	6	0.003	0.001	0.005	0.002
Nickel (mg/l)*	6	0.003	0.002	0.004	0.000
Silver (mg/l)*	3	0.000	0.000	0.000	0.000
Strontium (mg/l)*	3	0.817	0.168	1.000	0.670
Vanadium (mg/l)*	6	0.0020	0.0005	0.0026	0.0014
Zinc (mg/l)*	6	0.010	0.006	0.020	0.000
Tin (mg/l)*	2	<0.005	<0.002	<0.006	<0.003
Aluminum (mg/l)*	6	0.017	0.012	0.030	0.000
Gallium (mg/l)*	2	0.002	0.000	0.002	0.002
Germanium (mg/l)*	2	<0.006	<0.002	<0.007	<0.004
Lithium (mg/l)*	6	0.009	0.001	0.010	0.008
Selenium (mg/l)*	6	0.001	0.000	0.001	0.001
Titanium (mg/l)*	1	<0.002	-	<0.002	-
Zirconium (mg/l)*	1	<0.005	-	<0.005	-
Gross Beta (PC/L, CS-137)*	2	<0.0043	<0.0020	<0.0057	0.0029
Chlorophyll A (mg/l)	6	0.0021	0.0017	0.0051	0.0005
Chlorophyll B (mg/l)	6	0.0013	0.0014	0.0033	0.0000
Phenols (mg/l)	8	0.003	0.003	0.007	0.000
Dissolved Solids (mg/l)*	8	498.	31.	559.	467.
Gross Alpha (mg/l U)*	2	<0.0065	<0.0013	0.0074	<0.0056
Gross Beta (PC/L Sr_{90}/Y_{90})*	2	0.0035	0.0017	0.0047	0.0023
Bromide (mg/l)	8	0.10	0.04	0.1	0.0

* Elements analyzed for dissolved fraction

TABLE II-5

SUMMARY OF STREAMBED MINERALOGY
AT THE WHITE RIVER GAUGING SITES

Mineral	Percent Composition: Mean	Standard Deviation	Maximum	Minimum
Quartz	51	8	61	38
Potassium Feldspar	8	1	9	6
Plagioclase Feldspar	7	1	8	6
Calcite	9	2	14	6
Dolomite	8	2	12	5
Clay Minerals	14	3	20	10
Analcime	1	0	2	1
	98			

TABLE II-6

BOD AND COLIFORM TEST RESULTS FOR THE WHITE RIVER:
NOVEMBER 1975 THROUGH FEBRUARY 1976

		BOD	Total Coliform	Fecal Coliform	Fecal Strep
November	S-1	1.4	4	3	17
	S-3	1.4	4	1	23
	S-4	1.5	3	2	23
	S-11	2.3	0	0	6
December	S-1	-	11	20	2
	S-3	-	5	23	0
	S-4	-	4	14	18
	S-11	-	7	16	3
January	S-3	0.7	9	9	10
	S-11	0.3	16	8	12
February	S-3	1.4	2100	<3	<3
	S-11	1.7	93	<3	<3

TABLE II-7

SUMMARY OF SURFACE WATER QUALITY
EVACUATION CREEK AT WATSON (S-6)
BASE FLOW - JULY 25, 1975 - JAN. 6, 1976

Description	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
Temperature (°C)	9	12.6	7.9	22.3	2.0
Turbidity (JTU)	8	1756.	4555.	13000.	2.
Conductance (umhos)	9	4140.	1994.	5200.	454.
Chemical Oxygen Demand (mg/l)	8	140.	263.	790.	34.
pH (pH units)	7	7.7	0.3	8.1	7.4
Carbon Dioxide (mg/l)	6	12.5	8.7	28.	1.9
Alkalinity (mg/l $CACO_3$)	8	373.	153.	487.	126.
Bicarbonate (mg/l HCO_3)	8	454.	187.	594.	153.
Carbonate (mg/l CO_3)	8	0.	0.	0.	0.
Filterable Residue (mg/l)	2	2420.	-------	4100.	740.
Oil & Grease (mg/l)	7	2.0	4.4	12.	0.
Ammonia (mg/l N)*	8	0.009	0.016	0.04	0.00
Nitrite (mg/l N)*	8	0.016	0.017	0.05	0.00
Nitrate (mg/l N)*	8	0.72	1.71	4.9	0.00
Kjeldahl Nitrogen (mg/l N)	8	1.78	1.39	4.7	0.67
NO_2 + NO_3 (mg/l N)*	8	0.73	1.70	4.9	0.00
Orthophosphate (mg/l PO_4)*	8	0.018	0.022	0.06	0.00
Phosphorus (mg/l)	8	1.05	2.44	7.0	0.00
Orthophosphorus (mg/l P)*	8	0.006	0.007	0.02	0.00
Total Organic Carbon (mg/l)	2	16.5	-------	17.	16.
Total Inorganic Carbon (mg/l)	1	123.	-------	123.	-------
Cyanide (mg/l)	5	0.00	0.00	0.00	0.00
Sulfide (mg/l)*	8	0.13	0.10	0.3	0.0
Hardness (mg/l CO, Mg)	8	1023.	523.	1400.	180.
Non Carbonate Hardness (mg/l)	8	654.	374.	960.	48.
Calcium (mg/l)*	8	160.	70.	210.	49.
Magnesium (mg/l)*	8	152.	84.	220.	14.
Sodium (mg/l)*	8	741.	412.	980.	29.
Sodium Adsorption Ratio	8	9.3	4.4	12.	3.6
% Sodium	8	56.1	12.5	63.	26.
Potassium (mg/l)*	8	8.5	3.2	12.	1.9
Chloride (mg/l)*	8	49.	23.	75.	12.
Sulfate (mg/l)*	8	2125.	1202.	3000.	85.
Fluoride (mg/l)*	8	0.81	0.29	1.1	0.2
Silica (mg/l)*	8	10.4	2.6	14.	5.5
Arsenic (mg/l)*	5	0.0022	0.0015	0.004	0.000
Barium (mg/l)*	5	<0.140	0.114	<0.300	0.000
Berylium (mg/l)*	3	<0.009	0.002	0.010	<0.006
Bismuth (mg/l)*	1	0.040		<0.040	
Boron (mg/l)*	5	1.826	0.926	2.600	0.230
Cadmium (mg/l)*	5	0.000	0.000	0.000	0.000
Chromium (mg/l)*	5	<0.006	0.005	0.010	0.000
Cobalt (mg/l)*	5	0.0004	0.0005	0.001	0.000
Copper (mg/l)*	5	0.013	0.012	0.031	0.003
Iron (mg/l)*	5	0.036	0.043	0.110	0.000
Lead (mg/l)*	5	0.0006	0.0013	0.003	0.000
Manganese (mg/l)*	5	0.184	0.150	0.410	0.010
Mercury (mg/l)*	5	0.00002	0.00004	0.0001	0.0000
Molybdenum (mg/l)*	5	0.031	0.015	0.043	0.007
Nickel (mg/l)*	5	0.006	0.002	0.008	0.003
Silver (mg/l)*	3	<0.001	0.002	<0.003	0.000
Strontium (mg/l)*	3	4.133	0.115	4.200	4.000
Vanadium (mg/l)*	5	0.0009	0.0004	0.0013	0.0004
Zinc (mg/l)*	5	0.014	0.015	0.040	0.000
Tin (mg/l)*	1	0.040	-------	<0.040	-------
Aluminum (mg/l)*	5	0.030	0.035	0.090	0.010
Gallium (mg/l)*	1	-------	-------	<0.010	-------
Germanium (mg/l)*	1	-------	-------	<0.025	-------
Lithium (mg/l)*	5	0.092	0.050	0.140	0.010
Selenium (mg/l)*	5	0.0004	0.0005	0.001	0.000
Titanium (mg/l)*	1	0.030	-------	0.030	-------
Zirconium (mg/l)*	1	0.050	-------	<0.050	-------
Gross Beta (PC/L, CS-137)*	2	22.	-------	26.	18.
Chlorophyll A (mg/l)	5	0.0033	0.0028	0.0068	0.0004
Chlorophyll B (mg/l)	5	0.0026	0.0025	0.0066	0.0002
Phenols (mg/l)	8	0.0043	0.0026	0.009	0.001
Dissolved Solids (mg/l)*	8	3648.0	1985.	4920.	281.
Gross Alpha (mg/l U)*	2	<0.026	-------	<0.043	<0.010
Gross Beta (PC/L Sr_{90}/Y_{90})*	2	18.	-------	21.	15.
Bromide (mg/l)	1	0.4	-------	0.4	-------

*Elements analyzed for dissolved fraction

TABLE II-8

SUMMARY OF SURFACE WATER QUALITY
EVACUATION CREEK AT MOUTH (S-1) BASE FLOW
July 14, 1975-January 8, 1976

Description	Number of Samples	Mean	Standard Deviation	Maximum	Minimum
Temperature (oC)	10	16.3	9.3	30.0	0.5
Turbidity (JTU)	8	4132.	11664.	33000.	0.
Conductance (μmhos)	10	3952.	1197.	5100.	1200.
Chemical Oxygen Demand (mg/l)	8	348.	910.	2600.	20.
pH (pH units)	9	7.8	0.6	9.0	7.3
Carbon Dioxide (mg/l)	8	18.	10.	30.	0.7
Alkalinity (mg/l $CACO_3$)	9	35.3	100.	435.	125.
Bicarbonate (mg/l HCO_3)	9	431.	122.	530.	152.
Carbonate (mg/l CO_3)	8	0.	0.	0.	0.
Filterable Residue (mg/l)	3	3467.	586.	3900.	2800.
Oil & Grease (mg/l)	7	0.3	0.5	1.	0.
Ammonia (mg/l N)*	8	0.02	0.02	0.04	0.00
Nitrite (mg/l N)*	8	0.02	0.01	0.03	0.01
Nitrate (mg/l N)*	8	0.37	0.43	1.1	0.01
Kjeldahl Nitrogen (mg/l N)	8	0.77	0.72	2.5	0.16
$NO_2 + NO_3$ (mg/l N)*	8	0.39	0.43	1.1	0.02
Orthophosphate (mg/l PO_4)*	8	0.017	0.022	0.06	0.00
Phosphorus (mg/l)	8	0.008	0.014	0.04	0.00
Orthophosphorus (mg/l P)*	9	0.005	0.007	0.02	0.00
Total Organic Carbon (mg/l)	2	13.5	---------	15.	12.
Total Inorganic Carbon (mg/l)	1	--------	---------	114.	--------
Cyanide (mg/l)	5	0.00	0.00	0.00	0.00
Sulfide (mg/l)*	8	0.10	0.09	0.2	0.0
Hardness (mg/l Ca, Mg)	9	991.	303.	1200.	260.
Non Carbonate Hardness (mg/l)	9	618.	196.	770.	130.
Calcium (mg/l)*	9	164.	41.	200.	62.
Magnesium (mg/l)*	9	137.	52.	170.	25.
Sodium (mg/l)*	9	608.	219.	760.	160.
Sodium Adsorption Ratio	9	8.3	2.1	10.	4.3
% Sodium	9	57.	4.0	60.	47.
Potassium (mg/l)*	9	8.6	1.3	11.	7.4
Chloride (mg/l)*	9	44.	13.	57.	20.
Sulfate (mg/l)*	9	1859.	632.	2300.	430.
Fluoride (mg/l)*	9	0.76	0.11	0.9	0.6
Silica (mg/l)*	9	9.2	1.5	11.	6.9
Arsenic (mg/l)*	5	0.0012	0.0008	0.002	0.000
Barium (mg/l)*	5	<0.140	0.055	0.200	<0.100
Beryllium (mg/l)*	2	0.010	-------	0.010	0.010
Bismuth (mg/l)*	0	-------	-------	--------	--------
Boron (mg/l)*	6	1.508	0.625	1.900	0.250
Cadium (mg/l)*	5	0.0002	0.0004	0.001	0.000
Chromium (mg/l)*	5	<0.006	0.005	0.010	0.000
Cobalt (mg/l)*	5	0.0006	0.0005	0.001	0.000
Copper (mg/l)*	6	0.009	0.010	0.029	0.002
Iron (mg/l)*	6	0.042	0.078	0.200	0.000
Lead (mg/l)*	5	0.0004	0.0005	0.001	0.000
Manganese (mg/l)*	6	0.077	0.040	0.130	0.030
Mercury (mg/l)*	5	0.0000	0.0000	0.0000	0.0000
Molybdenum (mg/l)*	5	0.046	0.006	0.053	0.039
Nickel (mg/l)*	5	0.004	0.002	0.006	0.001
Silver (mg/l)*	2	0.000	-------	0.000	0.000
Strontium (mg/l)*	2	4.000	-------	4.100	3.900
Vanadium (mg/l)*	5	0.0009	0.0003	0.0013	0.0006
Zinc (mg/l)*	5	0.010	0.000	0.010	0.010
Tin (mg/l)*	0	-------	-------	-------	-------
Aluminum (mg/l)*	5	0.012	0.008	0.020	0.000
Gallium (mg/l)*	0	-------	-------	-------	-------
Germanium (mg/l)*	0	-------	-------	-------	-------
Lithium (mg/l)*	5	0.124	0.027	0.170	0.100
Selenium (mg/l)*	5	0.0014	0.0017	0.004	0.000
Titanium (mg/l)*	0	------	-------	-------	-------
Zirconium (mg/l)*	0	------	-------	-------	-------
Gross Beta (pc/l, Cs-137)*	3	<23.	14.	37.	<9.5
Chlorophyll A (mg/l)	5	0.0014	0.0014	0.0032	0.0000
Chlorophyll B (mg/l)	5	0.005	0.007	0.0017	0.0000
Phenols (mg/l)	8	0.0034	0.0037	0.012	0.000
Dissolved Solids (mg/l)*	8	3455.	634.	3970.	2150.
Gross Alpha (mg/l U)*	3	<0.049	0.023	0.062	<0.023
Gross Beta (pc/l SR_{90}/Y_{90})*	3	<19.8	13.3	34.	<7.5
Bromide (mg/l)	3	0.	0.06	0.3	0.2

* Elements analyzed for dissolved fraction

The results of the BOD and coliform tests of November 1975 through February 1976 are given on Table II-9.

TABLE II-9

BOD AND COLIFORM TESTS FOR EVACUATION CREEK:
November 1975 through February 1976

		BOD (mg/1)	Coliform /100 ml	Fecal Coliform /100 ml	Fecal Strep /100 ml
November	S-2	1.5	0	2	125
	S-6	1.1	0	1	166
December	S-2	-	2	16	1
	S-6	-	1	36	0
January	S-2	0.8	0	0	2
	S-6	0.5	0	0	13
February	S-2	2.5	3	3	3
	S-6	2.8	3	3	3

The first-year streambed mineralogy samples are summarized on Table II-10.

TABLE II-10

SUMMARY OF THE STREAMBED MINERALOGY
AT THE EVACUATION CREEK GAUGING SITES
(7 samples)

	Percent Composition			
Mineral	Mean	Standard Deviation	Maximum	Minimum
Quartz	33	8	44	21
Potassium Feldspar	6	1	8	4
Plagioclase Feldspar	7	2	8	4
Calcite	14	3	18	11
Dolomite	17	5	27	12
Clay Minerals	14	2	15	10
Analcime	2	1	3	1
	93			

c. Hells Hole Canyon, Southam Canyon, Asphalt Wash

Water quality samples were collected in February at stations S-5 (Hells Hole Canyon at mouth), S-13 (Southam Canyon at mouth), and S-12 (Asphalt Wash at mouth). These results are now being reviewed and will be reported in the seventh quarterly report. The streambed mineralogy samples for the washes are summarized on Tables II-11 through II-13.

3. GROUND WATER LEVEL MONITORING

All levels available through January 15, 1976, will be reported in the First Year Environmental Baseline Report (FYEBR). The monthly static measurements for December, January, and February are reported on monthly well hydrographs (Figure II-1).

4. GROUND WATER QUALITY

As directed by the AOSS, in areas where more than 4.6 m (15 ft) of saturated alluvium was found (AG-1, 2, 3) a well point was set on bedrock and another, a few meters away, was set 0.6 m to 1.5 m (2 ft to 5 ft) under the water table. At all other locations (AG-4, 5, 6, 7, 8, 9) 4.6 m (15 ft) of saturated material was not found, and a single well point was set to bedrock (designated AG-4 lower, etc.). All wells were constructed using 2-in. I.D., 200-wall PVC pipe and slot-perforated plastic sand points 1.5 m (5 ft) long. All couplings were sealed with fast-drying glue. A 2.1-m (7-ft) length of 4-in. I.D. protective steel casing was set 1.2 m (4 ft) into the ground around each plastic pipe. The casing was fitted with anchor braces and cemented at ground surface.

As directed, all wells are to be sampled in January and June, and all upper and single wells are to be sampled in April, May, July, and August. All water levels are to be measured monthly.

In January, water samples were collected and analyzed from the new alluvial wells only. Figure II-2 illustrates stiff diagrams of water quality drawn from the preliminary water chemistry data. AG-5, 7, and 9 were dry wells from which no data were collected. No data were collected from AG-8 either because the water was at ground-surface level and the water froze.

TABLE II-11

SUMMARY OF THE STREAMBED MINERALOGY
AT THE HELLS HOLE CANYON GAUGING SITES
(3 Samples)

	Percent Composition			
Mineral	Mean	Standard Deviation	Maximum	Minimum
Quartz	22	3	25	19
Potassium Feldspar	6	3	9	4
Plagioclase Feldspar	12	11	24	5
Calcite	13	2	14	11
Dolomite	18	8	25	9
Clay Minerals	17	3	20	15
Analcime	2	1	3	1
	90			

TABLE II-12

SUMMARY OF THE STREAMBED MINERALOGY
AT THE SOUTHAM CANYON GAUGING SITES
(6 Samples)

	Percent Composition			
Mineral	Mean	Standard Deviation	Maximum	Minimum
Quartz	26	2	29	24
Potassium Feldspar	14	3	18	11
Plagioclase Feldspar	18	5	27	11
Calcite	9	1	10	8
Dolomite	5	1	6	4
Clay Minerals	10	4	15	5
Analcime	9	1	12	8
	91			

TABLE II-13

SUMMARY OF THE STREAMBED MINERALOGY AT THE ASPHALT WASH GAUGING SITES
(6 Samples)

	Percent Composition			
Mineral	Mean	Standard Deviation	Maximum	Minimum
Quartz	27	1	29	25
Potassium Feldspar	11	2	13	6
Plagioclase Feldspar	21	7	28	9
Calcite	12	2	15	10
Dolomite	7	5	19	<5
Clay Minerals	13	4	20	10
Analcime	6	1	7	5
	99			

C. WORK SCHEDULED

1. SURFACE WATER

Preparation for spring runoff on the White River will have top priority for the next quarter. All conductivity and temperature probes will be changed from the winter position to the spring position. Stations S-1, S-4 and S-5 will be reactivated, and the spring-summer flow measurement and sediment-sample schedules will go into effect April 1.

2. SURFACE WATER QUALITY

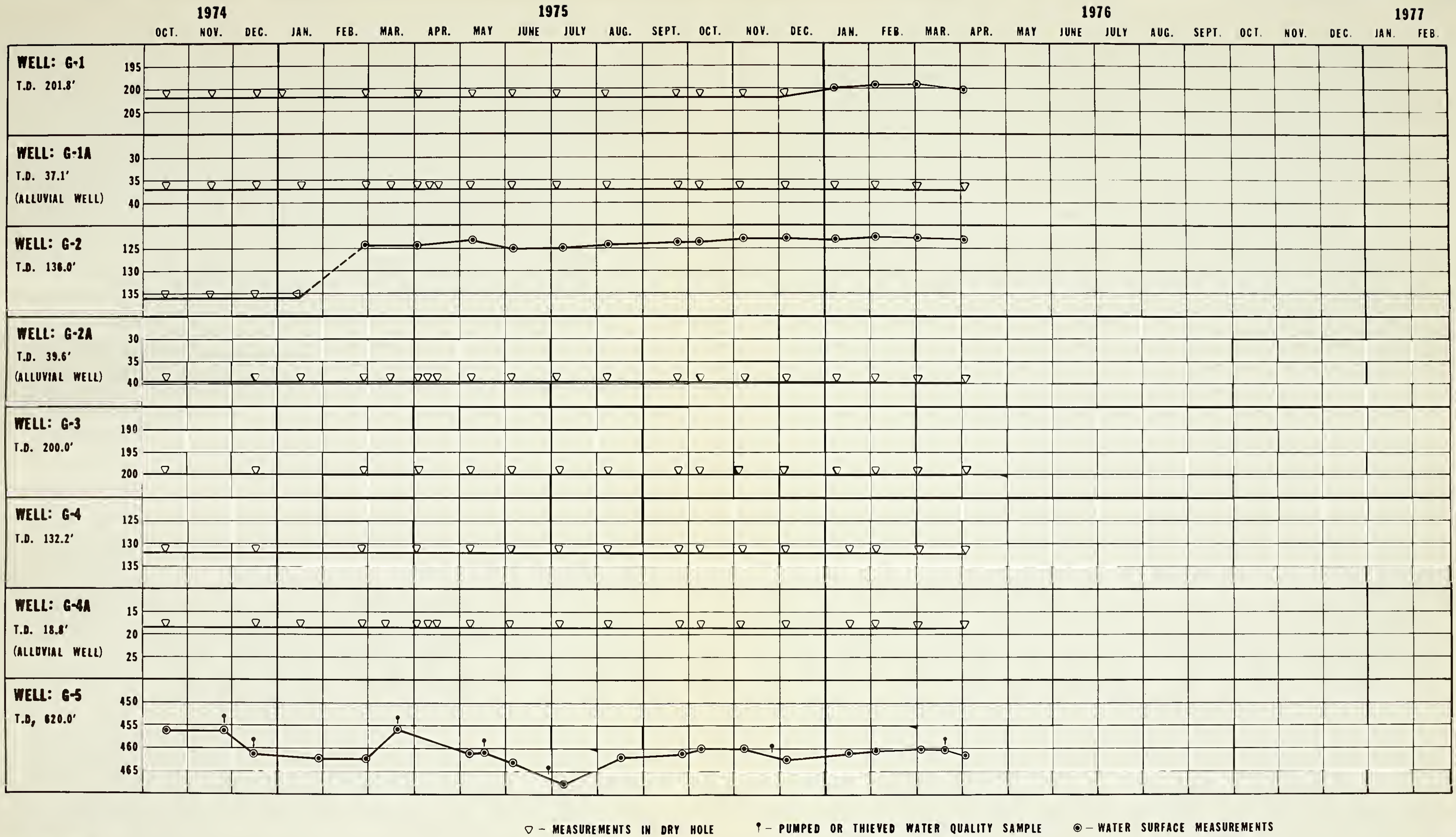
Sampling will continue in accordance with the revised conditions of approval. Continuous dissolved oxygen recorders will be installed one week at a time on a rotational basis between the stations on the White River and Evacuation Creek.

3. GROUND WATER LEVEL MONITORING

Water levels will be measured monthly in all wells and will be continuously recorded at the four sites of record.

4. GROUND WATER QUALITY

Quarterly pumped samples will be collected in March from the bedrock aquifer wells and in April from the alluvial wells specified by the AOSS.

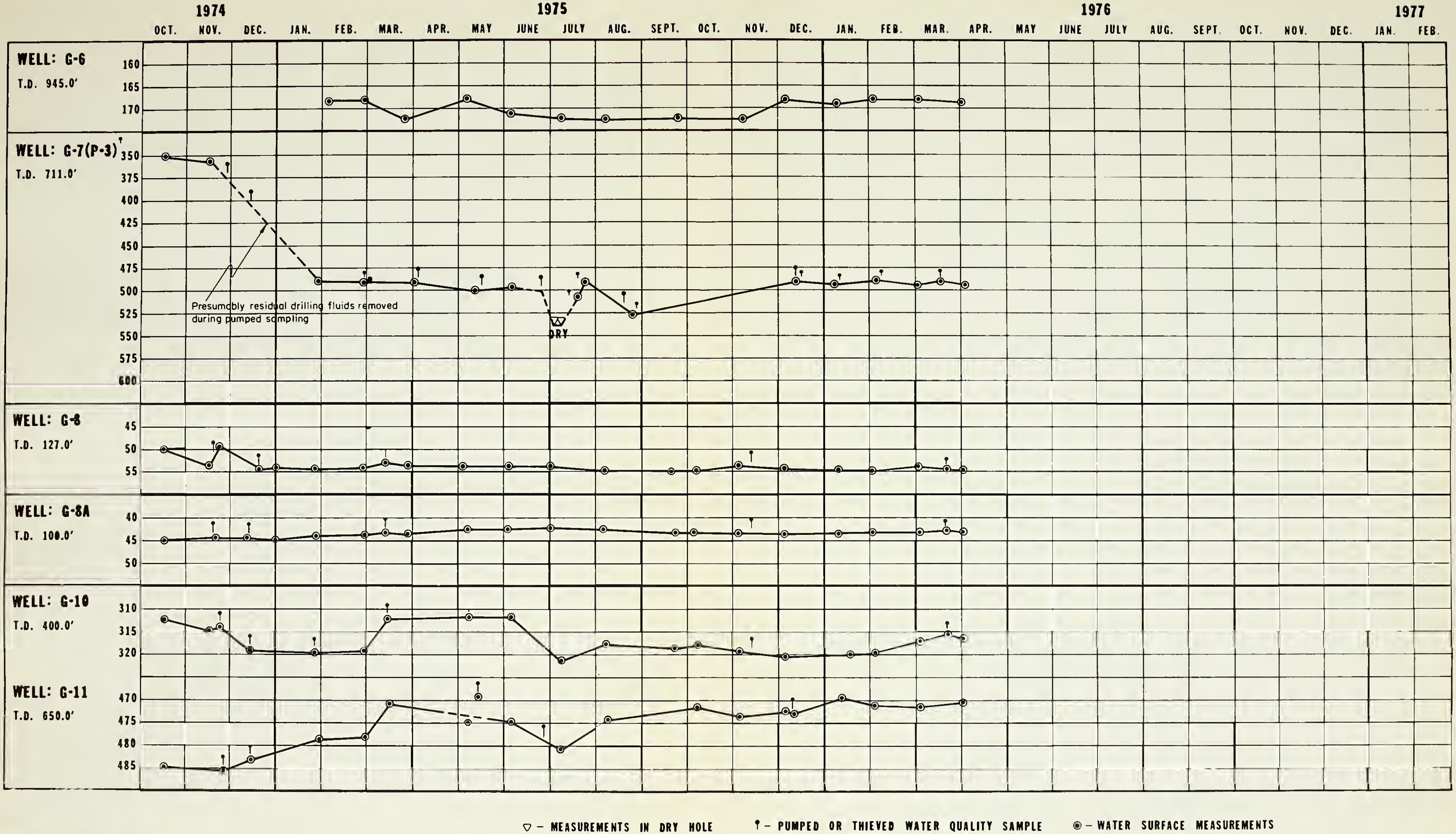


vtn

MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

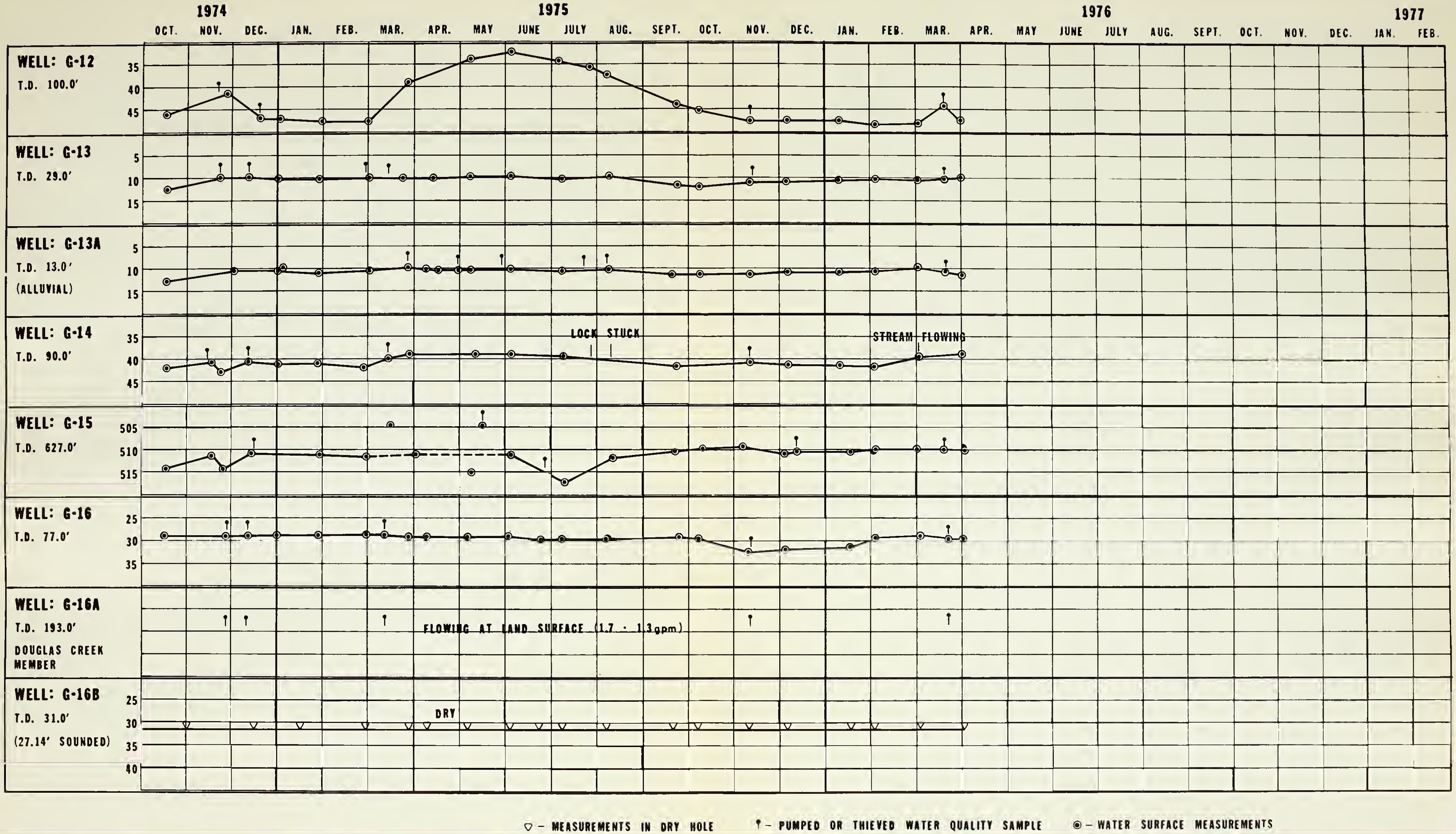
FIGURE II-1



MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

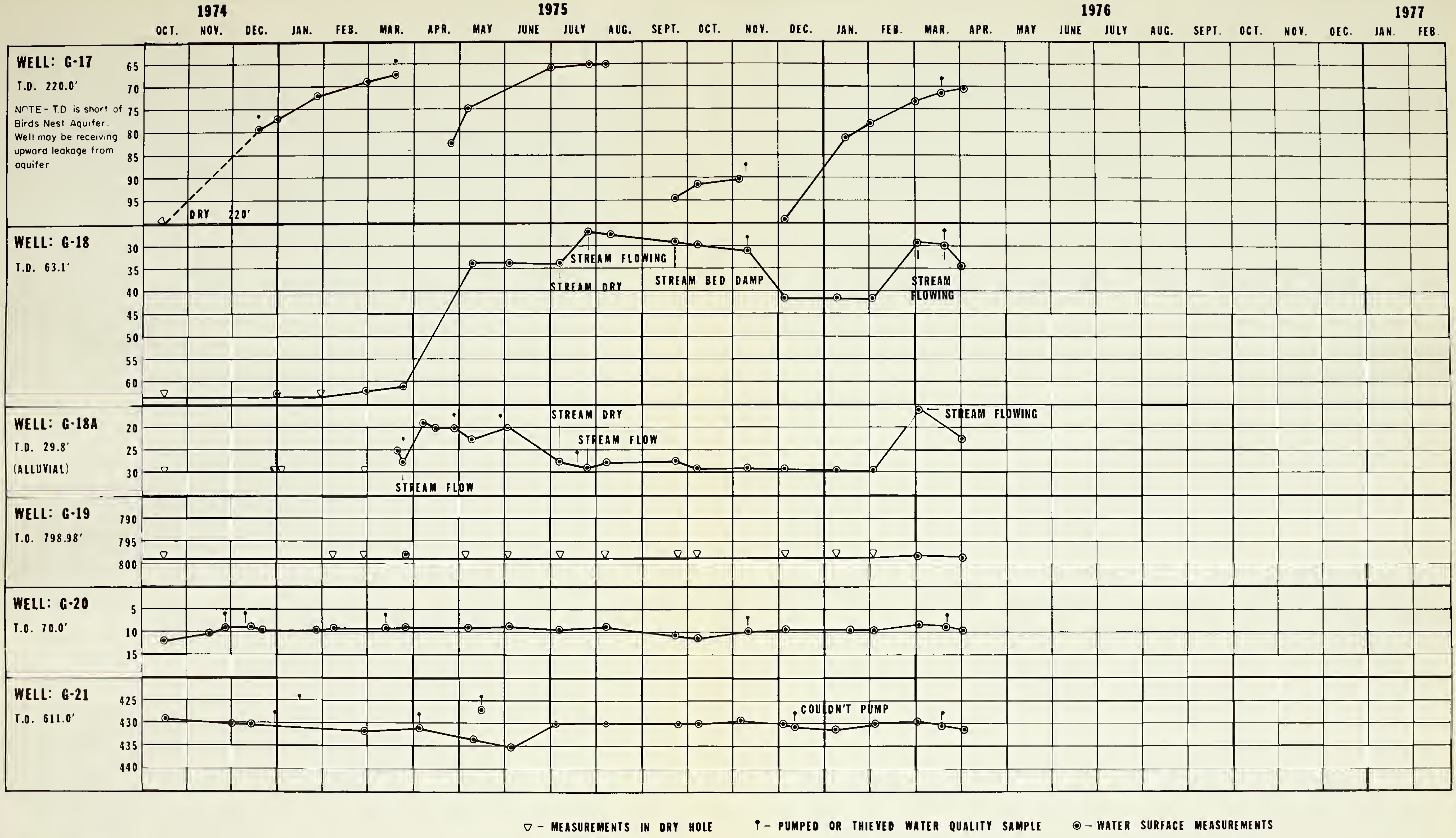
FIGURE II-1 (CON'T)



MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

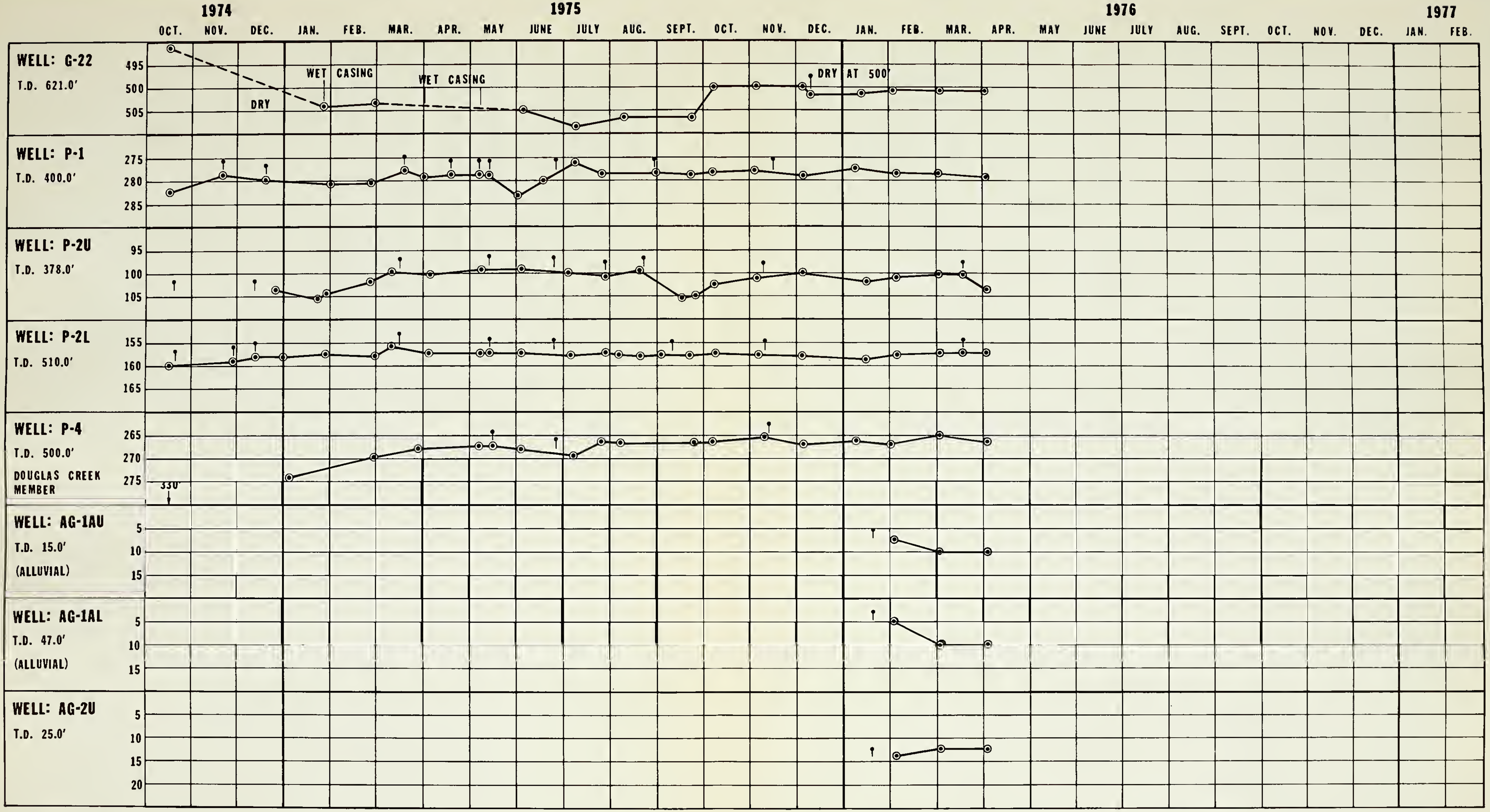
FIGURE II-1 (CON'T)



MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

FIGURE II-1 (CON'T)

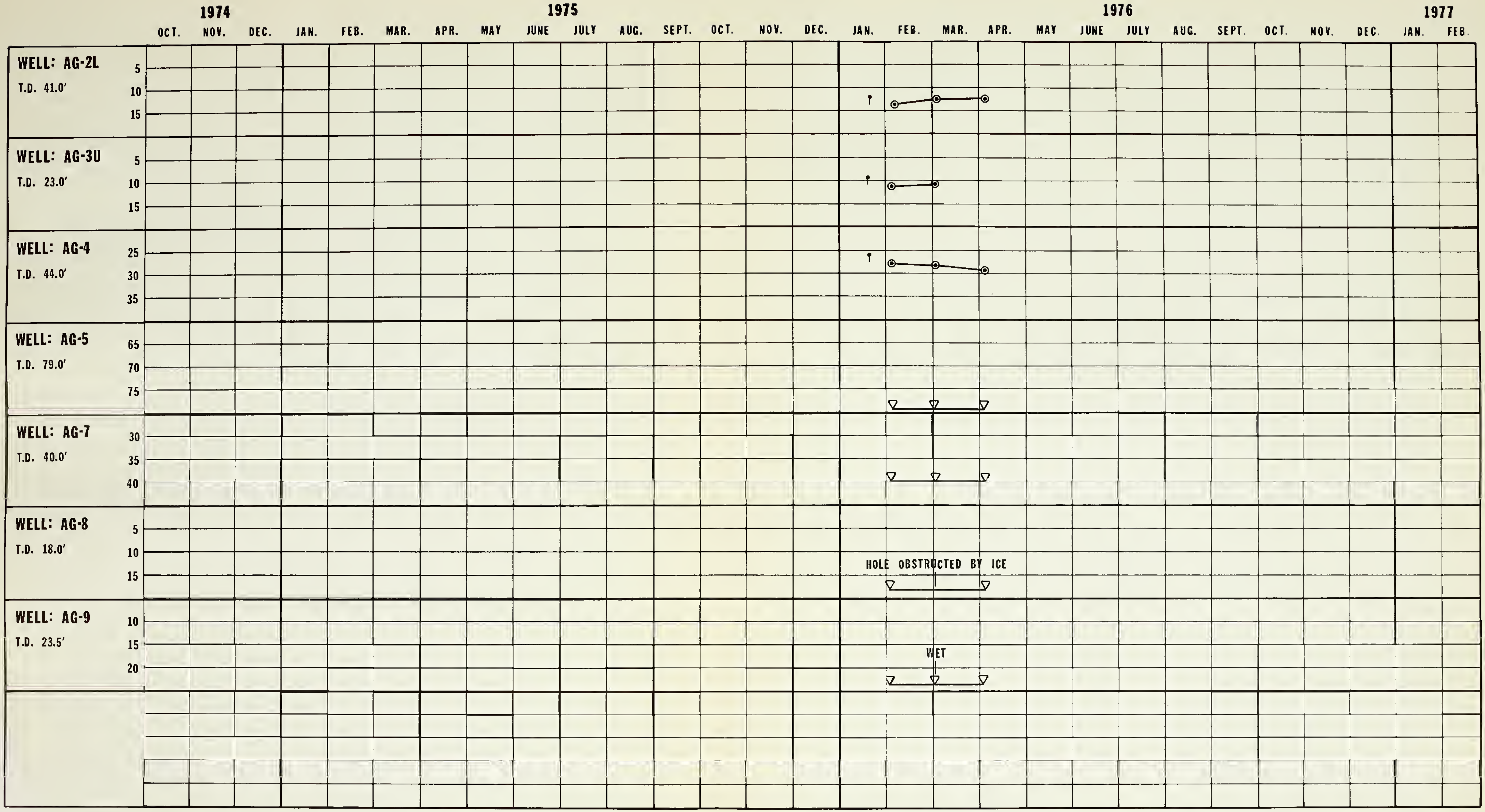


▽ – MEASUREMENTS IN DRY HOLE † – PUMPED OR THIEVED WATER QUALITY SAMPLE ◉ – WATER SURFACE MEASUREMENTS

MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

FIGURE II-1 (CON'T)



▽ – MEASUREMENTS IN DRY HOLE ꜛ – PUMPED OR THIEVED WATER QUALITY SAMPLE ⊙ – WATER SURFACE MEASUREMENTS

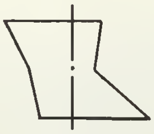
MONTHLY MEASURED STATIC WATER LEVELS IN WELLS

WHITE RIVER SHALE PROJECT TRACTS Ua & Ub

FIGURE II-1 (CON'T.)

AG-1A UPPER

WHITE RIVER OPPOSITE MOUTH HELLS HOLE CANYON



1,635

AG-1A LOWER

WHITE RIVER OPPOSITE MOUTH HELLS HOLE CANYON

689

AG-2 UPPER

WHITE RIVER OPPOSITE MOUTH SOUTHAM CANYON

586

AG-2 LOWER

WHITE RIVER OPPOSITE MOUTH SOUTHAM CANYON

526

SCALE

20 10 0 10 20

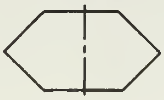
(me/l) CATIONS (me/l) ANIONS

LEGEND

(me/l) Na + K — Cl (me/l)

(me/l) Ca — HCO_3 (me/l)

(me/l) Mg — SO_4 (me/l)



TDS

(mg/l)

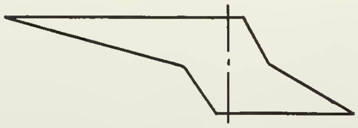
DISTRIBUTION OF MAJOR IONS IN ALLUVIAL GROUND WATER

JANUARY, 1976

FIGURE II-2

AG-3 UPPER

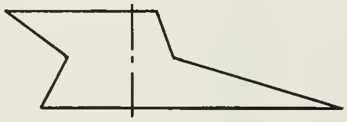
WHITE RIVER AT S-11



2,817

AG-3 LOWER

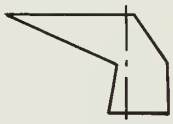
WHITE RIVER AT S-11



3,692

AG-4 LOWER

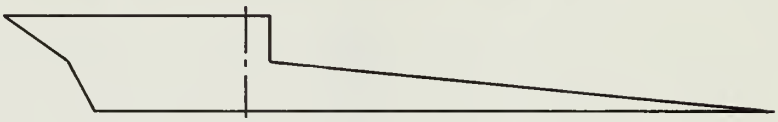
ASPHALT WASH NEAR WHITE RIVER



1,399

AG-6 LOWER

SOUTHAM CANYON NEAR WHITE RIVER



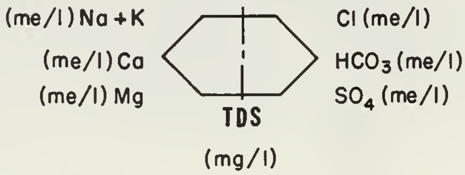
8,013

SCALE

20 10 0 10 20

(me/l) CATIONS (me/l) ANIONS

LEGEND



DISTRIBUTION OF MAJOR IONS IN ALLUVIAL GROUND WATER
JANUARY, 1976

FIGURE II-2 (CON'T)

III. AIR RESOURCES

A. WORK COMPLETED

During the quarter ending February 29, 1976, meteorology, air quality, radiation, and sound-level monitoring continued as stipulated in the provisions of the leases or prescribed by the Conditions of Approval for the environmental baseline monitoring program. Certain additional supporting measurements were taken at the request of the lease operators.

The Area Oil Shale Supervisor (AOSS) and the lessees agreed that the first year of baseline monitoring would include the period of January 16, 1975, through January 15, 1976. A complete report of the first-year measurements was submitted to the AOSS.

The following program modifications authorized by the AOSS were implemented at the end of January 1976:

1. Termination of upper air rawinsonde measurements

2. Termination of acoustic radar measurements

3. Termination of noise surveys

4. Termination of pressurized ion chamber and hand-held radiation monitor measurements of ambient radioactivity (thermoluminescent dosimeter measurements continue)

5. Termination of the AISI tape sampler measurements of the coefficient of haze (COH), effective January 16

The changes in items 1 through 4 were approved because one year of data for these parameters was considered sufficient. The COH measurements were terminated because the COH values on the tracts were indistinguishable from zero, and no additional information would be derived from further measurements by this urban-monitoring technique.

With the exception of these changes, routine measurements continued by the established continuous or regular schedules. Most of the air-monitoring instruments were calibrated at the end of February. The remaining instruments will be calibrated in March. In addition to regular quarterly calibrations of the gaseous pollutant analyzers and the bi-annual high-volume sampler calibrations,

more frequent zero and span checks will be made for most air pollutant instruments. The zeroes of the O_3 and SO_2/H_2S instruments are checked every 3 days using activated charcoal filters, and the zeroes of the chemiluminescent NO/NO_x analyzers are checked by shutting off their ozone generators. The spans of the $THC/CH_4/CO$ chromatographs are checked every 3 days by injection of a known concentration of CH_4 and CO from calibration gas cylinders. Static (electrical) span checks of the O_3 and NO/NO_x instruments are also made at the same intervals using an internal light-emitting diode to simulate the chemiluminescence.

The percentage of data collected during the three-month period from November 1, 1975, through January 31, 1976, is tabulated in Table III-1. (Since data processing requires a one-month lead time, most of the February data are not available.) The table lists the percentage of hours that data for each parameter was collected. Calibration time is included in data-collection time. Only the required parameters are tabulated. As shown on Table III-1, air quality was monitored 100 percent of the November-January period, and any given parameter was monitored at least 99 percent of the time. Meteorological monitoring was conducted 100 percent of the period at a number of stations, and each of the specified parameters was monitored 100 percent of the time.

B. DATA SUMMARY

Analysis of the air-resources data from this quarter is presented in the following sections. Meteorological conditions are included in Section 1; diffusivity is characterized in Section 2; air quality is described in Section 3; and radiation and noise levels are discussed in Sections 4 and 5, respectively.

1. METEOROLOGY

a. Surface Meteorology

Typical airflow patterns on the tracts during the early morning hours (0400 MST to 0700 MST) and afternoon (1400 MST to 1600 MST) are presented on Figures III-1 and III-2. The solid arrows in the figures are wind vectors at monitoring sites, and the longer lines are estimated flow streamlines. In the early morning hours airflow was of the drainage type; flow was toward low terrain and down

TABLE III-1

PERCENTAGE OF TIME MONITORING
WAS PERFORMED DURING THE PERIOD
1 NOVEMBER 1975 - 31 JANUARY 1976

Component	Number of Stations	Percentage
H_2S	8	100
SO_2	8	100
Susp. Part.	8	100
HC	3	99
NO_x	3	100
O_3	8	100
Wind (10 m)	12	100
Wind (20 m)	2	100
Wind (30 m)	2	100
Temp. (10 m)	7	100
Δ Temp. (30-10 m)	2	100
Rel. Hum. (10 m)	2	100

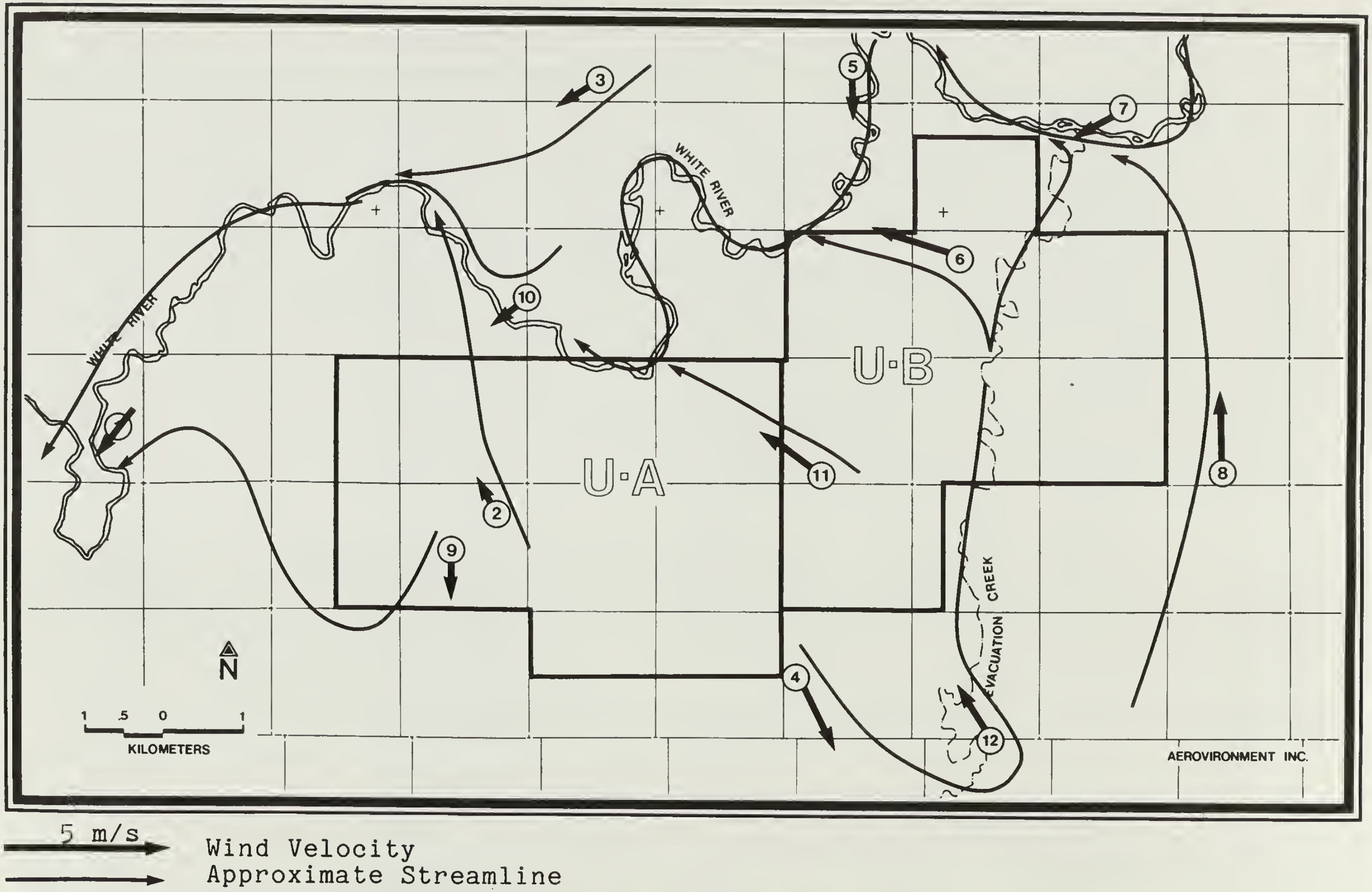


FIGURE III-1. TYPICAL AIRFLOW PATTERN ON TRACTS U-a AND U-b IN THE MORNING IN JANUARY 1976.

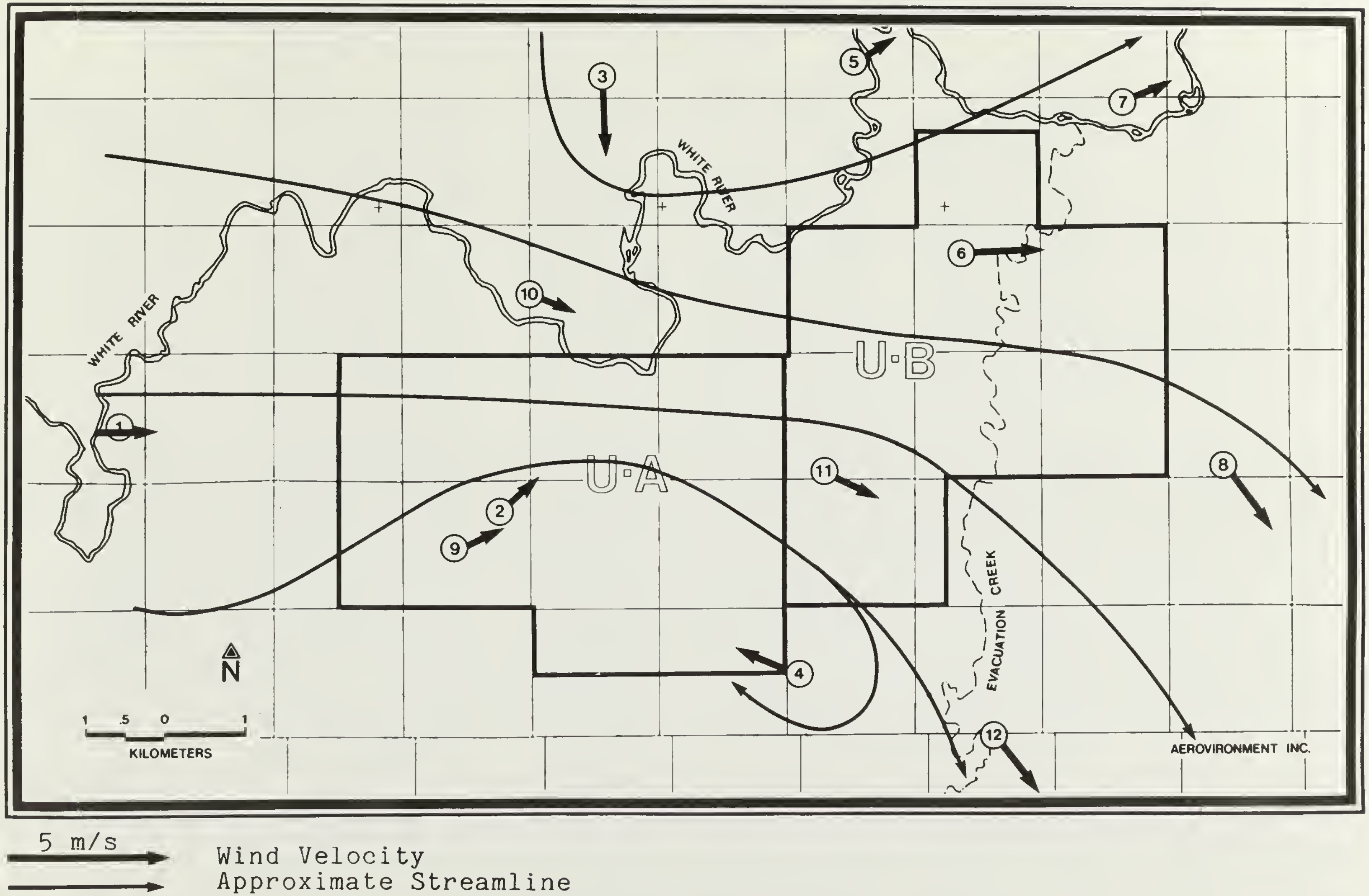


FIGURE III-2. TYPICAL AIRFLOW PATTERN ON TRACTS U-a AND U-b IN THE AFTERNOON IN JANUARY 1976.

the White River channel. This phenomenon has been observed throughout the monitoring program. The afternoon winds were more organized and were dominated by the synoptic scale pressure gradient. The airflow pattern is generally west to east. The return flow of Station A-4 is probably a localized phenomenon attributable to vortical motions induced by the complicated topography surrounding the station's ridge-top location.

The diurnal variation of mean wind speeds and their standard deviation at Station A-6 in January are plotted on Figure III-3. Winds were higher at night, caused by drainage flows augmented by very cold air near the earth's surface during winter. Winds decreased from nighttime speeds of 4 m/s (9.0 mph) to an average low of 2 m/s (4.5 mph) at about 1000 MST to 1100 MST as drainage effects were replaced by the pressure gradient force.

The frequency distribution of wind speed and wind direction at Station A-6 in January is presented as a wind rose in Figure III-4. Wind speeds were usually low. Less than 10 percent of all readings registered higher than 5.4 m/s (12 mph). Forty-four percent of the winds were between 3.7 m/s to 5.4 m/s (6 mph to 12 mph) and were mostly from the east.

Spatial variation in wind speed and wind direction over the tracts is indicated on Figures III-1 and III-2. This is a consequence of the complicated terrain features in the area. Wind speeds over the ridges and widely exposed terrain were generally higher than wind speeds in protected valleys.

Figure III-5 presents the diurnal variation in temperature in January at Station A-6. Average nighttime values were around -10°C (14°F), and average afternoon values were around -3°C (27°F). The daily maximum temperature was generally 1400 MST to 1500 MST, and the daily minimum temperature was between 0500 MST to 0700 MST. Temperatures were usually lower in protected valleys than in open terrain. The lowest temperature reading was -30°C (-22°F), observed at Station A-10 on January 2.

A plot of the diurnal variation in relative humidity in January at Station A-6 is presented on Figure III-6. Nighttime relative humidity was around 80 percent; the afternoon relative humidity was about 50 percent. This diurnal trend is similar to the temperature plot in Figure III-5. The amount of water vapor in the air remains constant during the day, since the relative humidity varies roughly as 1/T if the water vapor content is constant.

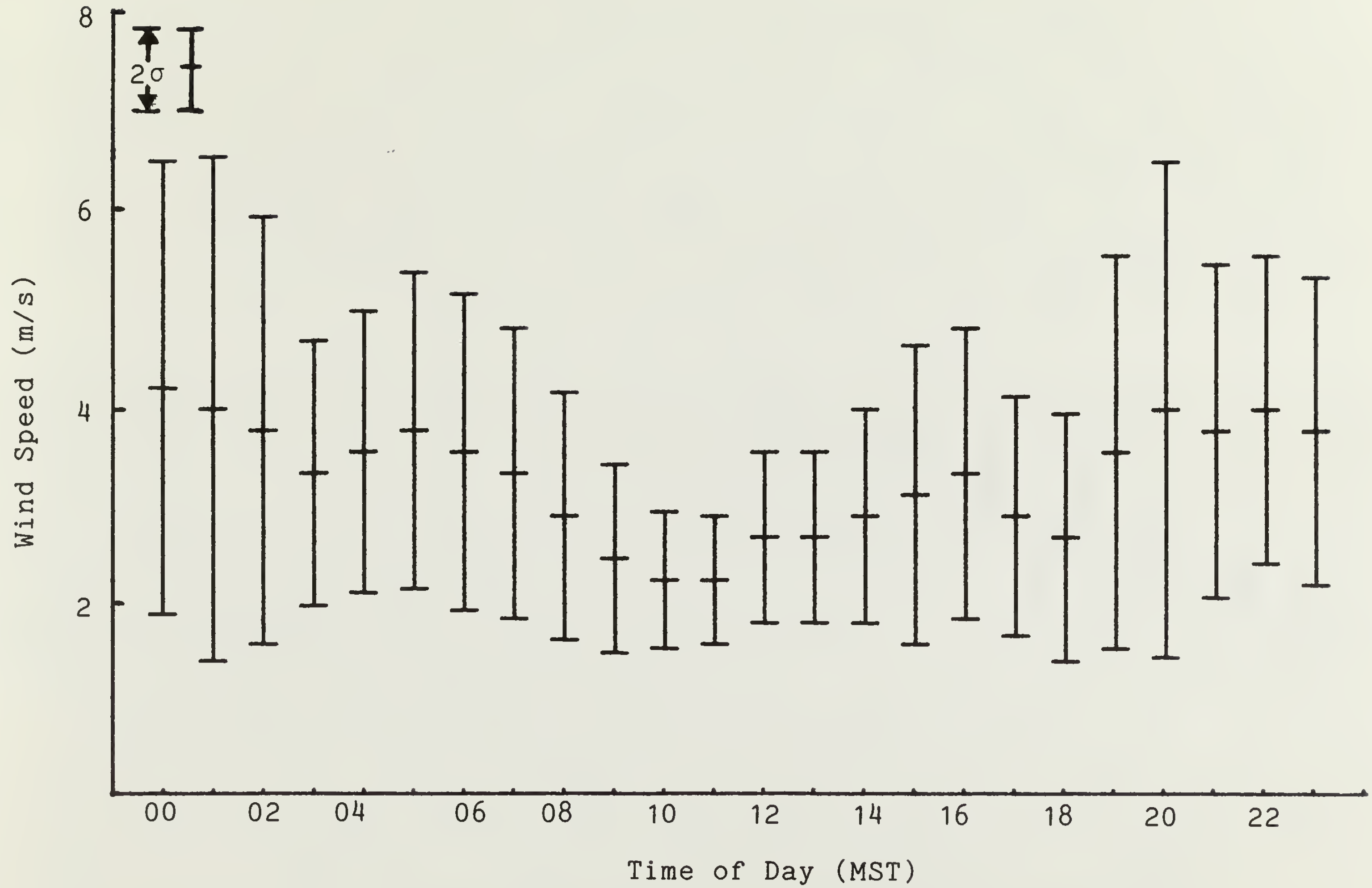


FIGURE III-3. DIURNAL VARIATION OF MEAN WIND SPEEDS AND THEIR STANDARD DEVIATIONS AT STATION A-6 IN JANUARY 1976, A TYPICAL WINTER MONTH.

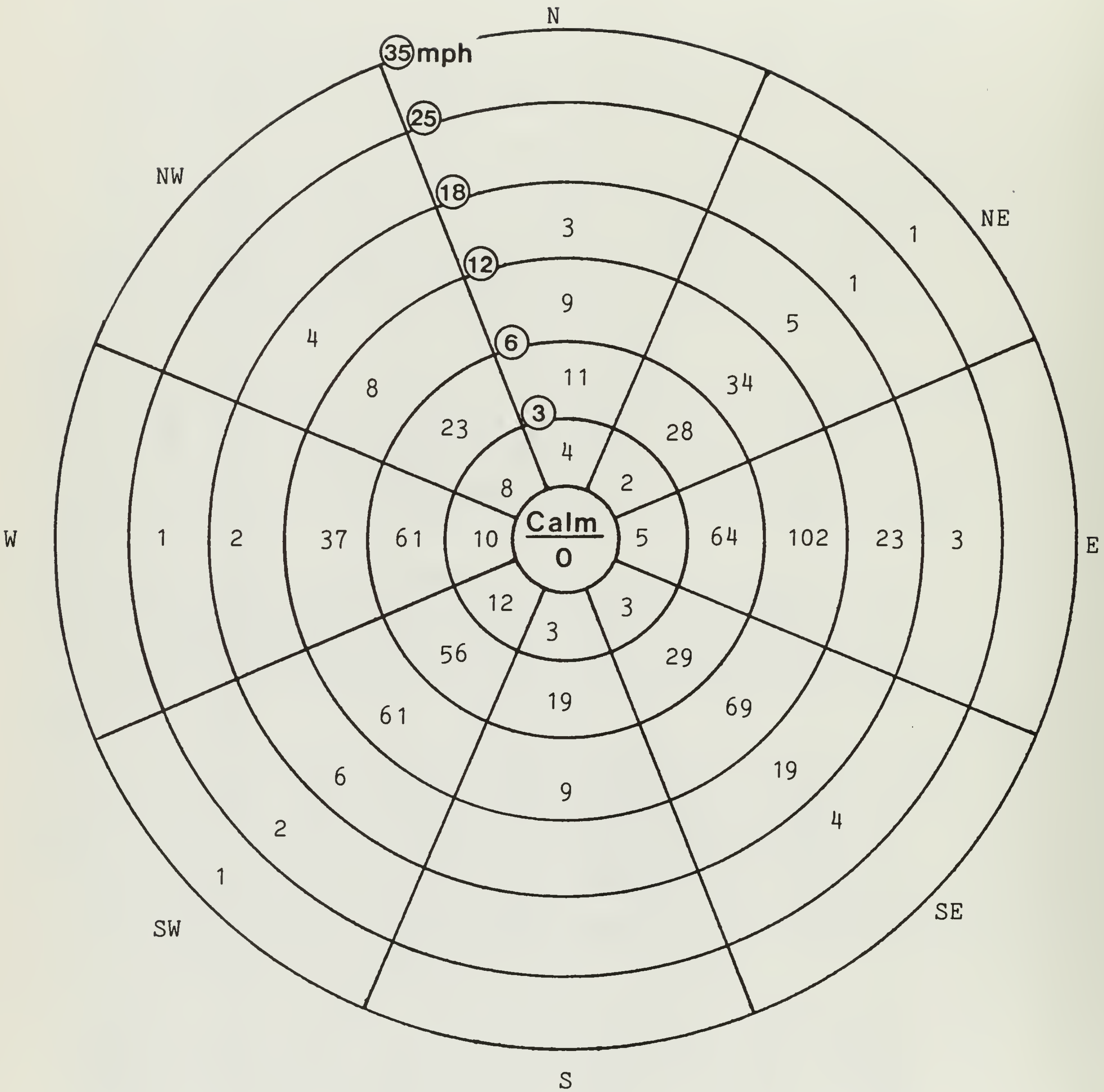


FIGURE III-4. FREQUENCY DISTRIBUTION (IN HOURS) OF WIND SPEED AND DIRECTION AT STATION A-6 IN JANUARY 1976.

Circled numbers are wind speed readings in mph (multiply by 0.447 to get speeds in m/s).

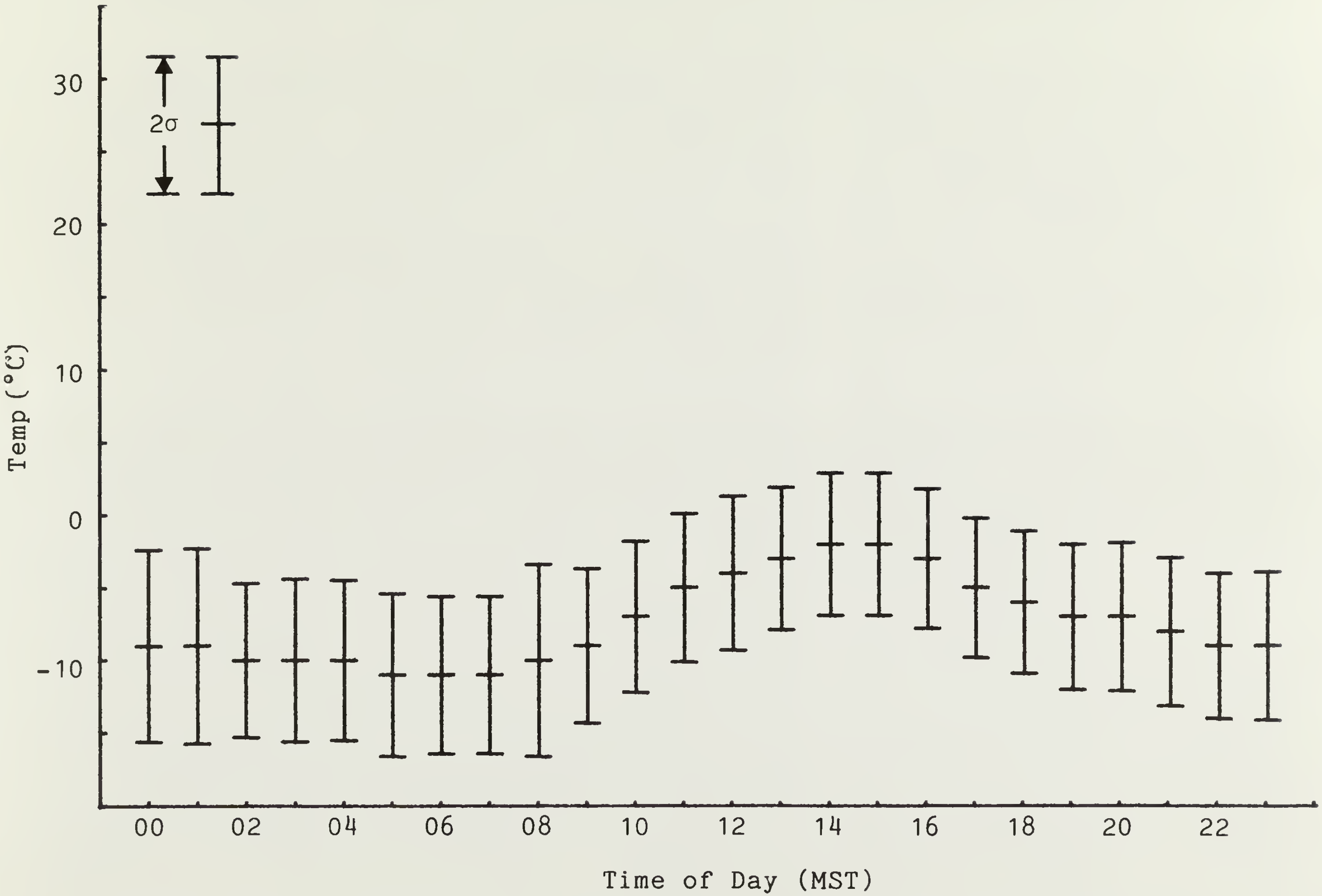


FIGURE III-5. DIURNAL VARIATION OF MEAN TEMPERATURES AND THEIR STANDARD DEVIATIONS AT STATION A-6 IN JANUARY 1976.

Multiply values by 1.8 and add 32 to get °F.

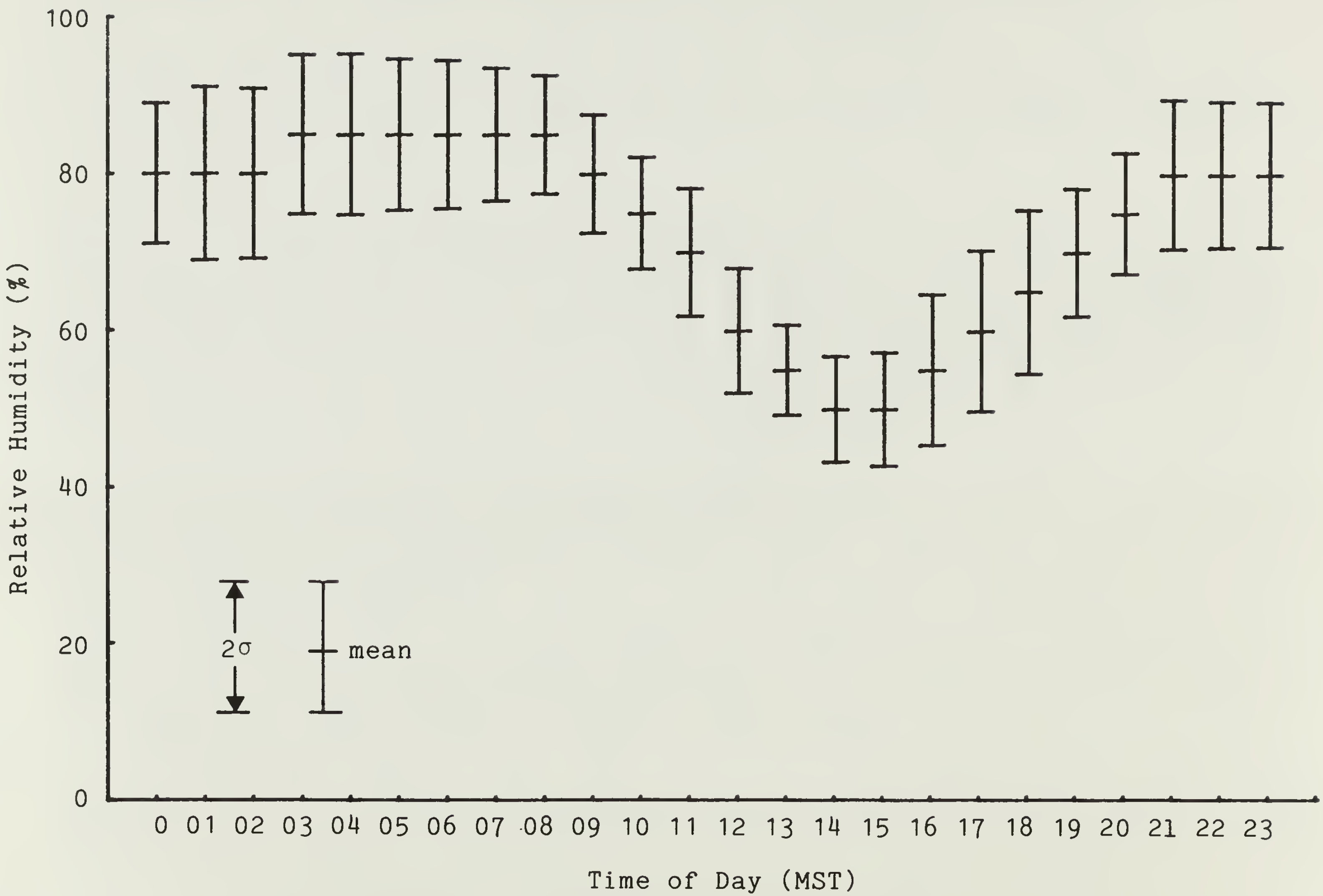


FIGURE III-6. DIURNAL VARIATION OF MEAN RELATIVE HUMIDITY READINGS AND THEIR STANDARD DEVIATIONS AT STATION A-6 DURING JANURARY 1976.

b. Upper-Air Meteorology

Radiosonde measurements of temperature, relative humidity, and wind in the upper atmosphere and continuous monitoring of the turbulence structure of the bottom kilometer of the atmosphere by means of an acoustic radar were terminated on January 31, 1976, as discussed in Section III.A.

Before measurements were discontinued, a surface-based temperature inversion was observed in 88 percent of the morning soundings. The average thickness of this inversion was 605 m (1,985 ft), varying from 100 m to 1,603 m (328 ft to 5,259 ft). The average strength of the inversion was 1.8°C/100 m, ranging from 0.9°C/100 m to 4.0°C/100 m. The inversion was a result of radiational cooling of the earth's surface at night. As the sun rises in the morning, the earth is warmed by the sun's rays, which heat the air from below and destroy the inversion layer. No surface-based inversions were observed in the afternoon.

Upper-air inversions were frequently detected. These inversions were associated with anticyclones, common in late fall and winter throughout the Great Basin. Fifty-three percent of all morning soundings and 87 percent of all afternoon soundings indicated upper-air inversions. The average thickness of the morning upper-air inversion was 253 m (830 ft), with an average strength of 0.7°C/100 m. The thickness varied from 53 m to 591 m (174 ft to 1,939 ft) and the strength ranged from 0.1°C/100 m to 2.1°C/100 m. The average base height of the morning upper-air inversions was 1,647 m (5,404 ft) above ground level. The average base of the afternoon upper-air inversions was about 930 m (3,050 ft). The average thickness of the afternoon inversions was 286 m (938 ft), and the average strength was 0.9°C/100 m. Their thicknesses extended from 20 m to 850 m (70 ft to 2,790 ft) while the lapse rate ranged from isothermal to 3.0°C/100 m.

The temperatures measured higher than 1,000 m (3,300 ft) above the ground were almost static throughout the day. The average temperatures at 1,000 m and 2,000 m (3,300 ft and 6,600 ft) above the surface were -8°C and -14°C (18°F and 7°F), respectively. The upper-air relative humidity was higher in the morning than in the afternoon. At ground level the relative humidity was 70 percent in the morning and 55 percent in the afternoon, and between 2 km to 3 km (1 mi to 2 mi) above the ground, the morning relative humidity was around 60 percent and the afternoon relative humidity was about 50 percent. Winds between 2 km and 3 km (1 mi to 2 mi) above the ground were usually from the west or northwest at about 3 m/s to 5 m/s (7 mph to 11 mph).

The results of rawinsonde soundings on a typical winter day (January 19, 1976) are given on Figures III-7 and III-8. In the morning, a strong surface-based inversion extended to 200 m (660 ft) above ground level. This was topped by an isothermal layer about 450 m (1,480 ft) deep. This stable layer of about 650 m (2,130 ft) thick disappeared in the afternoon; however, an upper-air inversion about 400 m (1,300 ft) thick persisted throughout the day. The base of the upper-air inversion varied from 1,500 m (4,900 ft) above the surface in the morning to 1,000 m (3,300 ft) in the afternoon. Descending warm, dry air associated with anticyclones is depicted by the temperature plots and by the humidity soundings, which indicate a drastic upward reduction in moisture beginning at the base of the inversion. On this day, winds in the first kilometer (0.6 mi) were about 1 m/s (2 mph) and were generally from the northeast.

c. Normality of Measurement Period

The normality of meteorological conditions on the tracts was analyzed by comparing rawinsonde data collected by the National Weather Service at Grand Junction during the monitoring program with corresponding historical meteorological records. Since there is a six-month delay between collection and release of upper-air data from Grand Junction, the months of July, August, and September were tested.

Comparisons of meteorological data at 700 mb, the first standard barometric level above all of the terrain at Grand Junction and Tracts U-a and U-b, are given on Table III-2. Wind-speed deviations from the ten-year norm were between 1 m/s to 2 m/s (2 mph to 4 mph), with no systematic bias. Except during the morning soundings in August, relative humidities varied from the norm less than 10 percent. Temperatures were consistently normal in all months. Meteorological conditions of July through September at Grand Junction can be considered normal, and relatively representative of conditions on the tracts.

2. DIFFUSIVITY

Dispersion or dilution of windborne effluents in the atmospheric boundary layer greatly depends on the turbulence intensity or the diffusivity of the atmosphere. The diffusivity on the tracts can be characterized by a number of routine meteorological measurements. One of these is the upper-air sounding. The preceding discussion of upper-

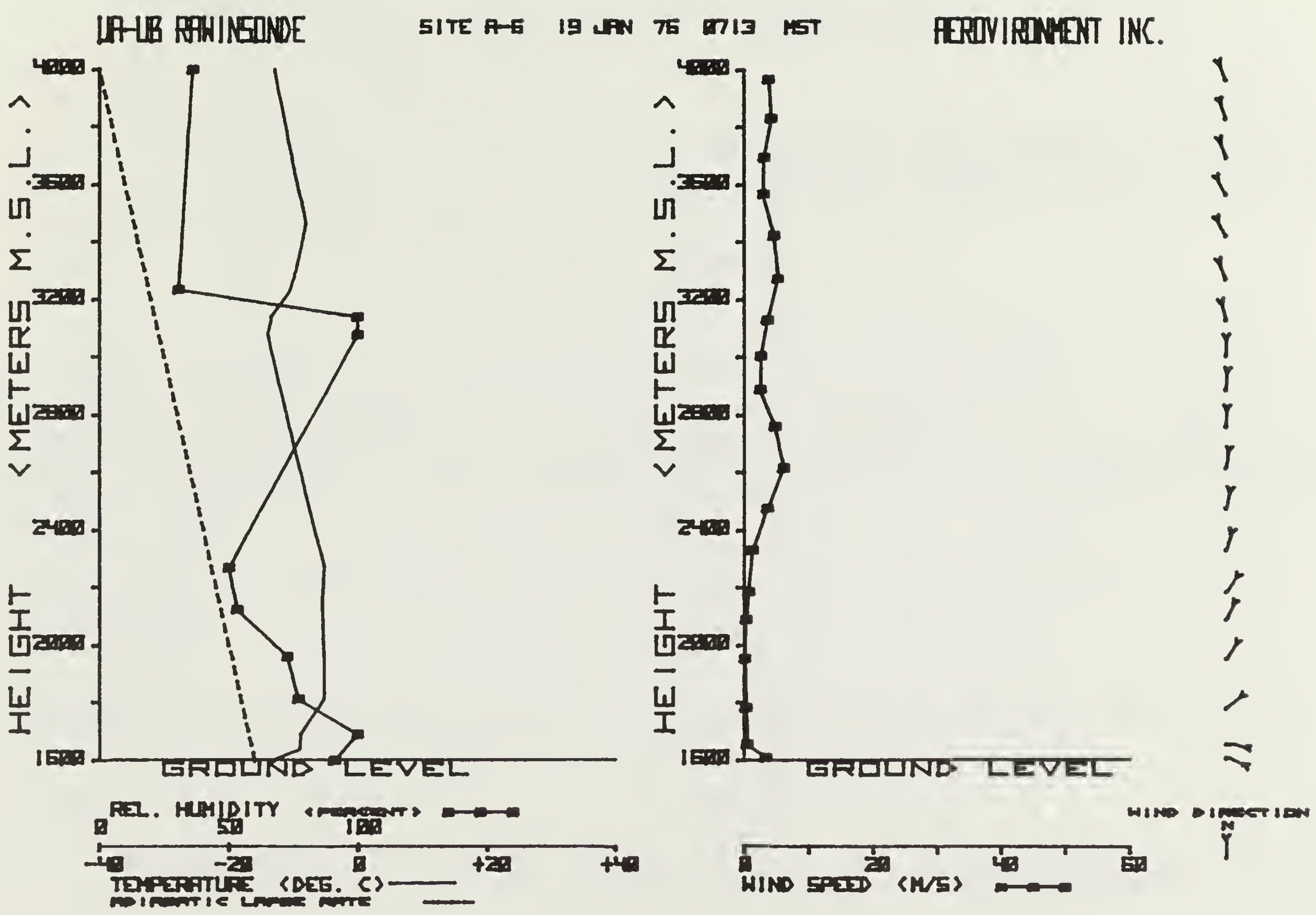


FIGURE III-7. RAWINSONDE SOUNDING AT 0713 MST ON 19 JANUARY AT STATION A-6.

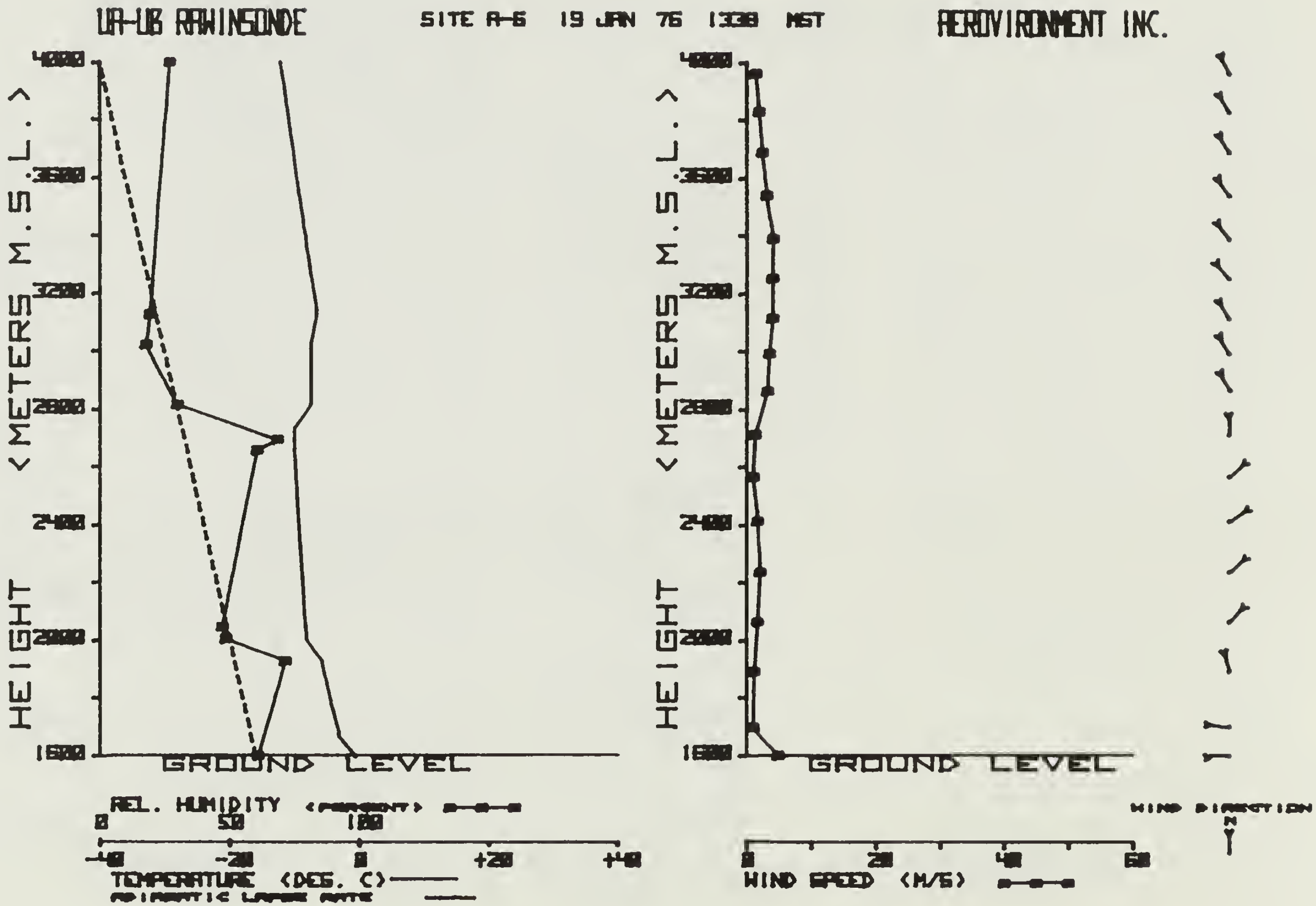


FIGURE III-8. RAWINSONDE SOUNDING AT 1338 MST ON 19 JANUARY AT STATION A-6.

TABLE III-2

UPPER AIR DATA

Comparison of 700 mb. monthly average upper air data at Grand Junction, Colorado from July 1975 through September 1975 with their corresponding ten-year means. The 10-year norm, and the duration of current data from this norm, are tabulated.

	Morning (0500 MST) Soundings						Afternoon (1700 MST) Soundings					
	Wind Speed (m/s)		Temp (°C)		Rel. Hum. (%)		Wind Speed (m/s)		Temp (°C)		Rel. Hum. (%)	
Month	Norm	Dev	Norm	Dev	Norm	Dev	Norm	Dev	Norm	Dev	Norm	Dev
Jul	3.0	-1.0	13.0	-0.5	40	6	2.7	-1.1	15.2	-0.3	31	6
Aug	3.1	0.8	11.6	-0.3	46	-11	2.6	1.2	14.0	-0.5	34	-3
Sep	4.4	-1.9	7.0	0.5	45	-5	4.5	-1.9	9.2	0.7	36	-3

air meteorology showed that during the last quarter, mixing in early morning hours was limited close to the ground by surface-based inversions, with an average strength of 2°C/100 m and an average depth of 606 m (1,985 ft). Surface-based inversions usually disappeared in the afternoon. Subsidence inversions with an average thickness of 253 m (830 ft) and an average strength of 0.7°C/100 m were frequently observed. The average base height of these upper-air inversions was 1,647 m (5,403 ft) above the surface in the morning and 930 m (3,050 ft) in the afternoon.

Another approach to characterizing the diffusivity is to compare temperatures at two surface stations in close proximity to each other but at different elevations. The temperature comparison at stations A-6 and A-2 shows the normal trends over the 1,610 m to 1,628 m (5,282 ft to 5,455 ft) range. Figure III-9 shows the average temperatures and their standard deviations at stations A-2, A-4, and A-6 at 0500 MST and 1400 MST in January. The data are plotted against the height of the station to give a "sounding" of temperature. In the early morning hours, the temperature at Station A-4 was higher than that at stations A-2 and A-6; in the afternoon all three temperatures were almost identical, which correlates with the existence of surface-based inversions in the morning and neutral conditions in the afternoon above Station A-6.

Table III-3 presents the frequency distributions for the month of January at Station A-6. The data indicate that diffusion conditions were low in January. None of the recorded values were higher than 0.80 m/s. The diffusivity (in terms of $\sqrt{\sigma_v \sigma_w}$) typically ranged from 0.2 to 0.4 m/s.

This approach to diffusion-estimation data presents quantitative measurements of actual diffusion. Using generally accepted boundary layer formulas and measured lapse-rate data from the rawinsonde, these values can often be extrapolated upward to allow estimation of conditions at levels above the 30-m (100-ft) tower tops.

The findings in this section further substantiate earlier conclusions that conditions adverse to mixing occur most frequently in winter.

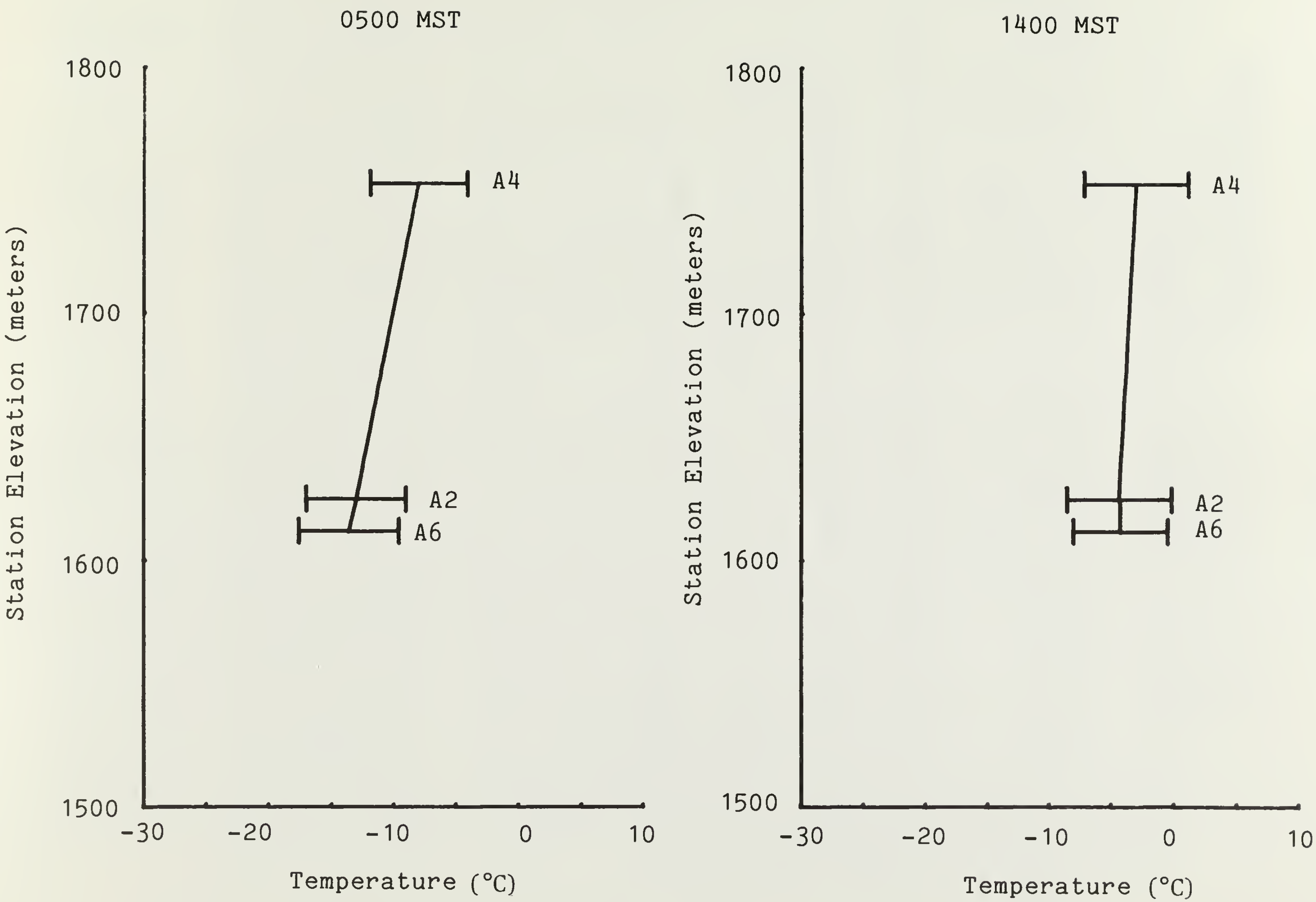


FIGURE III-9. AVERAGE JANUARY TEMPERATURES (0500 AND 1400 MST) AND STANDARD DEVIATIONS AS A FUNCTION OF STATION ELEVATION.

TABLE III-3

DIFFUSIVITY[1]

Relative frequency distribution (%) of $\sqrt{\sigma_v \sigma_w}$ (m/s) at Station A-6 in January. All measurements were made at 30 m above the surface. All hours of the day are included.

$\sqrt{\sigma_v \sigma_w}$ Range*	0.00	0.20	0.40	0.60	0.80	>0.80	Total # of Obs.
% Frequency	1	79	18	2	<1	0	743

* Each interval of $\sqrt{\sigma_v \sigma_w}$ spans 0.2 m/s and commences with the value shown.

σ_V is the root-mean-square turbulence fluctuations in the lateral wind speed (v).

σ_W is the root-mean-square turbulence fluctuations in the vertical wind speed (w).

1 Mathematical formulations for diffusivity are contained in Quarterly Report #5.

3. AIR QUALITY

a. Gaseous Pollutants

Sulfur dioxide and H_2S are monitored at eight sites on the tracts. In addition, CO, HC, NO_2, and O_3 are monitored at three of the eight sites. There are federal standards for all components except H_2S. For reference in the following discussion, the Federal Ambient Air Quality Standards (AAQS) for the various gaseous pollutants monitored on the tracts are given on Table III-4. For H_2S, a reference for interpreting the data is the California 1-hour standard of 42 $\mu g/m^3$ (0.03 ppm).

The air quality on the tracts has been consistently good, as expected because of the remote location. Except for sporadic occurrences of high non-methane hydrocarbon (NMHC) readings, the air during this quarter contained low levels of gaseous pollutants. The only other pollutant present in measurable quantities was ozone. Almost all instruments measuring other gaseous pollutants recorded at their threshold limit most of the time.

The 6 A.M. to 9 A.M. NMHC standard of 160 $\mu g/m^3$ was exceeded occasionally, and 3-hour averages of twice the standard were often observed. However, it should be noted that the federal standard for NMHC of 160 $\mu g/m^3$ (0.24 ppm) for the 3-hour period from 6 A.M. to 9 A.M. was established to reduce the formation of photochemical pollutants (for which separate standards exist also) and not as a health standard per se. The NMHC standard is frequently exceeded in unpopulated areas throughout the United States, so the levels on the tracts are not unusual.

The diurnal variations of ozone at Station A-6 in January are plotted in Figure III-10. The average diurnal trend consisted of low readings of about 50 $\mu g/m^3$ (0.03 ppm) between 0300 to 1000 in the early morning hours and higher values of 80 $\mu g/m^3$ (0.04 ppm) between 1400 to 1700 in the afternoon. Very little dirunal variation was observed for all other pollutants. Variations in the levels of gaseous pollutants has consistently been small from station to station.

Table III-5 shows the peak-period values for all gaseous pollutants recorded on the tracts during the quarter. Values are given for time averages for which air quality standards exist. The data presented are representative of the worst air quality conditions on the tracts during

TABLE III-4

FEDERAL AIR QUALITY STANDARDS
FOR GASEOUS POLLUTANTS

Pollutant	Averaging Time	Primary Standards	Secondary Standards
Ozone (O_3)	1 hour	160 $\mu g/m^3$ (0.08 ppm)	same as primary
Carbon Monoxide (CO)	8 hours	10 mg/m^3 (9 ppm)	same as primary
	1 hour	40 mg/m^3 (35 ppm)	same as primary
Sulfur Dioxide (SO_2)	Annual Average	80 $\mu g/m^3$ (0.03 ppm)	-
	24 hour	365 $\mu g/m^3$ (0.14 ppm)	-
	3 hour	-	1300 $\mu g/m^3$ (0.5 ppm)
Nitrogen Dioxide (NO_2)	Annual Average	100 $\mu g/m^3$ (0.05 ppm)	same as primary
Hydrocarbons (corrected for methane) (NMHC)	3 hour (6-9 a.m.)	160 $\mu g/m^3$ (0.24 ppm)	same as primary

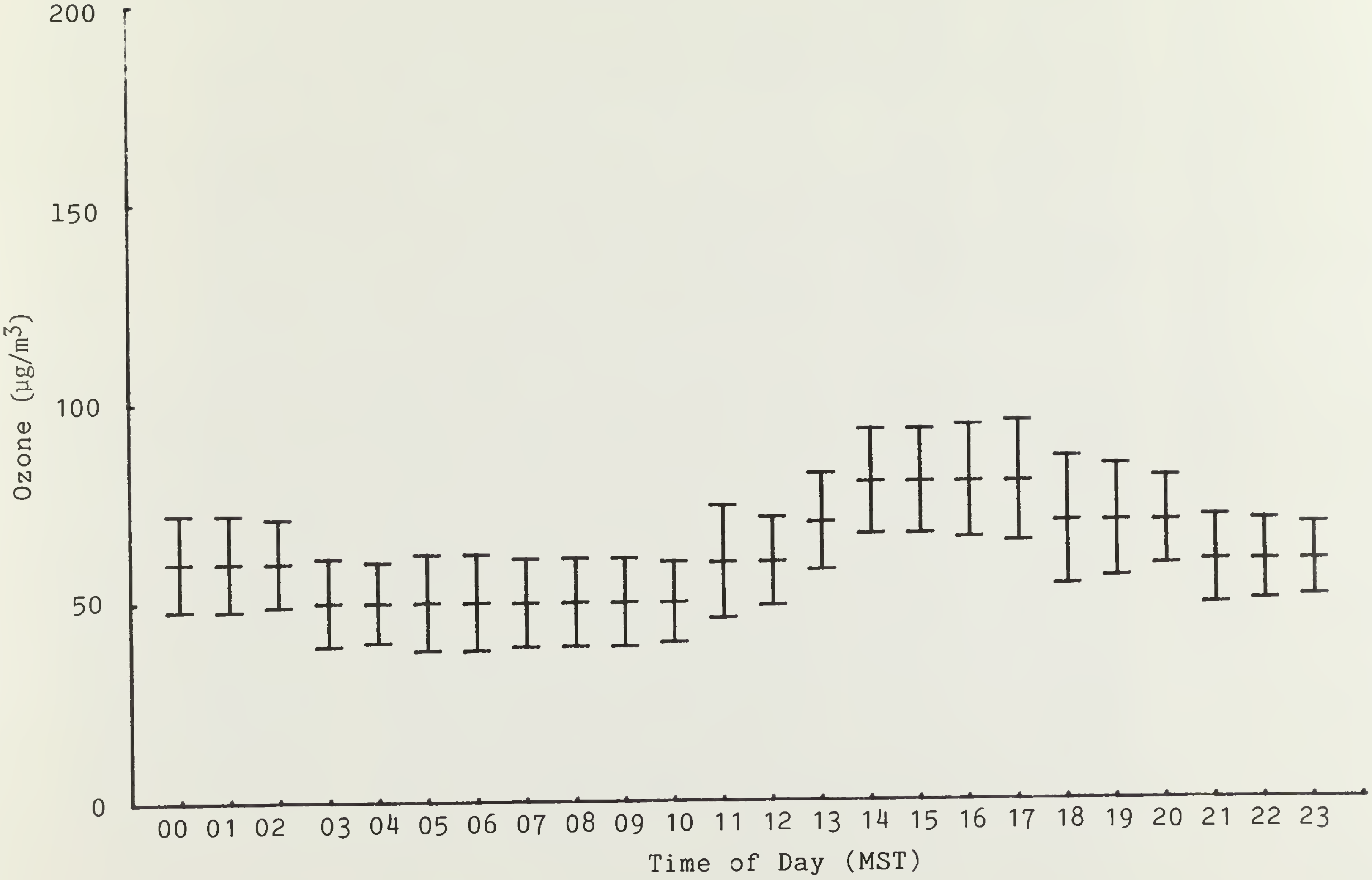


FIGURE III-10. OZONE CONCENTRATIONS.

Diurnal variation in mean ozone concentrations with their standard deviations at Station A-6 during winter, based on data for the central month of the quarter.

TABLE III-5

PEAK GASEOUS POLLUTANTS CONCENTRATIONS

Peak period values of all gaseous pollutants observed on the tracts in the winter quarter, for averaging times consistent with Federal Air Quality Standards.

Pollutant	Averaging Time	Concentration	Standard
O_3	1 Hour	110 $\mu g/m^3$	160 $\mu g/m^3$
CO	8 Hours	1.3 mg/m^3	10 mg/m^3
	1 Hour	1.8 mg/m^3	40 mg/m^3
SO_2	24 Hour	25 $\mu g/m^3$	365 $\mu g/m^3$
	3 Hour	30 $\mu g/m^3$	1300 $\mu g/m^3$
	1 Hour	30 $\mu g/m^3$	--
NO_2	1 Hour	20 $\mu g/m^3$	--
NMHC	3 Hour (6-9 A.M.)	1640 $\mu g/m^3$	160 $\mu g/m^3$
H_2S	1 Hour	5 $\mu g/m^3$	--

the season. Even so, these values are very low compared to the standards. All of them, except ozone and non-methane hydrocarbons values, are near the detection threshold of the instruments. In fact, H_2S and SO_2 variations are simply due to variability in instrument responses near their detection thresholds.

b. Particulates and Trace Metals

Particulate concentrations on the tracts are monitored by high-volume samplers that sample over a period of 24 hours once every 6 days simultaneously at all 8 air monitoring sites. The sizes of the particulates collected by the samplers range from below 1 μm to somewhat above 25 μm.

Table III-6 gives the geometric mean, standard geometric deviation, and maximum and minimum particulate concentrations in $\mu g/m^3$ recorded at all sites during the winter quarter. Data collected between December 1 through February 29 were used.

Because particulate concentrations have generally been log-normally distributed, the geometric mean given can be considered to correspond to the maximum expected concentration at a 50 percent frequency. The geometric mean of particulate concentrations ranged from 4.9 $\mu g/m^3$ at Station A-6 to 12.1 $\mu g/m^3$ at Station A-5. There was a noticeable spatial variation on the tracts. Station A-5, at the base of a cliff on the west bank of the White River and about 0.2 km west of the main dirt road linking Bonanza and the tracts, was the station with the highest particulate concentrations. Concentrations at all sites were above 69 $\mu g/m^3$ on December 2, 1975. Most of the rest of the measured values in this quarter were less than 10 $\mu g/m^3$. One cause for this drastic decrease was the presence of snow on the ground, which suppressed the introduction of dust and fine particles into the atmosphere by wind and vehicular activities.

None of the recorded values exceeded federal or state standards (given on Table III-7). The most stringent short-term standard is the National Secondary Standard, which sets the upper limits at 150 $\mu g/m^3$ averaged over 24 hours; this is not to be exceeded more than once a year.

Samples collected during this quarter were sent to the laboratory for trace-metal analysis. The results will be included in the next quarterly report.

TABLE III-6

PARTICULATE CONCENTRATIONS

The geometric mean, standard geometric deviation, maximum and minimum of particulate concentrations ($\mu g/m^3$) at Stations A-1 to A-8 in the winter quarter (December 1 through February 29).

Station	Geo. Mean	Standard Geo. Dev.	Maximum	Minimum
A-1	6.9	2.2	70.7	3.3
A-2	7.3	2.2	69.5	3.3
A-3	5.6	2.5	73.2	1.3
A-4	7.2	2.2	72.4	3.3
A-5	12.1	2.0	75.6	5.3
A-6	4.9	3.0	75.6	0.7
A-7	9.3	2.3	91.5	3.3
A-8	10.1	2.1	76.6	4.1

TABLE III-7

AMBIENT AIR QUALITY STANDARDS
FOR PARTICULATE MATTER ($\mu g/m^3$)

Pollutant	Averaging Time	Utah Standards	National Standard	
			Primary	Secondary
Suspended Particulate Matter	Annual Geometric Mean	90	75	60
	24 hour	200	260	150

c. Visibility

The clarity of the atmosphere on the tracts is monitored by three methods: (1) continuous recording of light-scattering coefficient with an integrating nephelometer at Station A-2; (2) photographic recording of visibility on color and monochromatic film from an observation point above Station A-9; and (3) visual observations during the photographic recording.

The integrating nephelometer recorded an average scattering coefficient of $0.04 \times 10^{-3}m^{-1}$ during this quarter, which corresponds to a local visual range (assuming a 2 percent contrast threshold for the eye) of 118 km (73 mi). The highest scattering (lowest visual range) recorded was $b_s = 0.12 \times 10^{-3}m^{-1}$, which corresponds to the 39 km (24 mi) observed several times during December. The clearest hours had $b_s = 0.02 \times 10^{-3}m^{-1}$ (visual range 235 km or 146 mi), which was last observed in the winter with snow on the ground. The clarity of this latter value is comparable to that of particle-free air. All observed values corresponded to extremely clear, background-quality air.

A diurnal variation in scattering coefficient was observed, with the night and early morning hours generally showing about 15 percent more scattering (lower visibility) than the afternoon and evening hours. This diurnal effect showed that fine-scale particulates (of natural or anthropogenic origin) collect near the ground during the stable, calm night hours and are mixed into the atmosphere during the better ventilated hours and that the increased human activity and winds on the tracts during the day do not stir up enough dust to counteract this stability. This variation was not present in the summer but was observed last winter and spring. All the exceptionally high values of scattering occurred in the daytime, indicating anthropogenic origins.

The visibility was photographed December 3, January 2, and February 1. In all three days no significant obstructions to visibility were recorded. The photographs taken at 1600 MST on December 3 are shown on Figure III-11. These photos clearly show the most prominent distant landmark, Blue Mountain, about 60 km to the northeast. The corresponding scattering coefficient at Station A-2 was $0.03 \times 10^{-3}m^{-1}$, or a visual range of 158 km (97 mi), which is consistent with the photographs. Some other landmarks at greater distances are obscured by clouds to the east and west.

a. West

b. Northwest

FIGURE III-11. PHOTOGRAPHIC VISIBILITY RECORD FOR 1600 ON 3 DECEMBER 1975.
The weather on this day was overcast and clouds obscured very remote terrain to the west. The photographs are spaced at 45° intervals around the horizon, and the field of view of each of about 35°. Sun glare caused the overexposure on the westward view.

c. North. Identification sign and control charts. Camera is focused on sign, so terrain is out of focus.

d. Northeast

FIGURE III-11 (Continued). Note clear appearance of distant Blue Mountain (indicated by arrow), some 60 km to the northeast.

e. East

f. Southeast

FIGURE III-11 (Continued). The Cathedral Bluffs (50 km to the east) are almost obscured by clouds.

The photographically-derived visibilities and those computed from the integrating nephelometer measurements correlate closely indicating that the Uintah Basin air mass is relatively homogeneous and that the localized nephelometer measurements are representative of a large area.

4. RADIATION

Continuous monitoring of ambient radiation throughout the tracts by a pressurized ion chamber, a portable ionization chamber survey meter, a NaI crystal scintillation counter, and thermo-luminescent dosimeters at all 12 stations show that radiation levels throughout the study area are in the normal ambient range. The pressurized ionization chamber, set up at each site in turn for 6 consecutive days, showed hourly exposure rates ranging from 15 μR/hr to 20 μR/hr. Localized sources in the vicinity of the monitoring sites have indicated values of up to about 50 μR/hr, still well within the background range.

The 30-day average radioactivity levels measured by thermoluminescent dosimetry at all 12 stations from December 24 through January 23 are tabulated on Table III-8. These values are consistent with the ionization chamber data and also with data from the previous quarters.

5. SOUND LEVELS

The sound level of the study area was last surveyed from January 14 through January 23. Sound level surveys have since been terminated, as discussed in Section III.A. Surveys in this quarter showed that in wind-free conditions the background sound level on the tracts was 24 dB(A) to 26 dB(A) and that air motion or insects was the dominant identifiable sound source. Locations near the White River indicated 29 dB(A) to 31 dB(A) with no wind, with the sound of water identified as a sound source. The highest sound level was 32 dB(A) 100 m from Station A-5. The noise of the generator was responsible for the high reading.

For reference, the threshold of hearing is 0 db(A), a quiet residential bedroom may be 25-30 dB(A), and a quiet office 40 dB(A). The sound level in forested or grassy regions is typically 50 dB(A) in no-wind conditions. OSHA occupational safety regulations prohibit exposure to more than 90 dB(A) for an 8-hour day. Because of limited water, vegetation, and human and animal activity, the sound environment on the tracts is quiet.

TABLE III-8

RADIATION LEVELS

Average radiation levels at all stations during 24 December to 23 January, as measured by three thermo-luminescent dosimeters at each station.

A-1	- 11 mR	A-7	- 13 mR
A-2	- 15 mR	A-8	- 11 mR
A-3	- 11 mR	A-9	- 12 mR
A-4	- 15 mR	A-10	- 13 mR
A-5	- 11 mR	A-11	- 17 mR
A-6	- 14 mR	A-12	- 13 mR

C. WORK SCHEDULED

Except for the activities terminated January 31 (discussed in Section III.A), routine continuous monitoring and data processing of all air resources parameters will continue throughout the next quarter.

Air quality instruments not calibrated in February will be calibrated in March. A final data volume of the first year of air-resources monitoring will also be submitted in the next quarter.

IV. BIOLOGICAL RESOURCES

A. WORK COMPLETED

1. VEGETATION

The 20 plots (5 plots in each of the 4 vegetation types: sagebursh-greasewood, juniper, shadscale, and riparian) were re-restablished for phenological observation in 1976.

2. TERRESTRIAL VERTEBRATES

The December and February sampling periods were completed as scheduled. This begins the second year of terrestrial-vertebrate assessment. Because of the cold weather, only birds and mammals were sampled.

The yearly deer-trend count for the project area was completed during mid-December. A helicopter was used because of cold weather and snow. Two days were spent surveying the entire project area. In upland areas, parallel courses were run at low air speeds and low elevations to locate deer in the area. Each segment of the riparian-area habitat, marked by the river meanders, was surveyed by flying low at slow speeds and flushing the deer from the heavy cover. This pattern was interrupted when fresh deer tracks were followed from the river to upland areas to determine the number of deer and their patterns of migration from the river bottoms. A winter survey of raptor populations was conducted during the deer-trend count, and an effort was made to locate any coyotes in the project area. Beaver caches were not counted in this quarter because the White River was frozen most of the time.

3. TERRESTRIAL INVERTEBRATES

Most of the work completed during the quarter centered around sending various insect groups to specialists for determination. At this time, only two groups (torymid wasps and microlepidotera) have been returned. Dr. Eric Grissell determined most of the torymids to the specific level, and Dr. Jerry Powell determined the microlepidoptera to the family level. In addition, Dr. Bohart determined numerous bees and sphecid and vespid wasps.

4. AQUATIC BIOLOGY

The tracts were visited in early January for examining periphyton materials and for sampling invertebrates. Sampling was virtually impossible because the White River was frozen except for a few open leads. Other work consisted of statistical analyses, revision of the Partial Exploration Plan, and preparation of the First Year Environmental Baseline Report.

5. MICROBIOLOGY

All available data from the sample analyses were coded onto standard Fortran coding forms and then key-punched onto standard computer cards. The data bank will be amended and supplemented as results become available. A program was designed to test the significance of the correlation between respiration and dehydrogenase activity.

The activities were tested statistically with respect to conditions defined by environmental variables. Because water-potential values are indicative of temperature and moisture in the soil and therefore of the soil environment, water-potential values were the basis for the descriptions of site conditions.

Since ATP is closely involved in the biochemical processes resulting in CO_2 evolution (respiration) and dehydrogenase activities, it was subjected to analyses as a fourth variable in order to further elaborate on relationships indicated in the preliminary tests. Standard statistical packages ("Statpacs") were incorporated into the programs wherever applicable and printout information, as well as a discussion of results, are included in the data summary.

B. DATA SUMMARY

1. VEGETATION

No new data are available for this quarter.

2. TERRESTRIAL VERTEBRATES

a. Small Mammals and Birds

Twenty-three species of birds were observed in December, and 29 species were observed in February. A review of the first year's data and this quarter's data indicate that 13 avian species are permanent residents, 4 are possible permanent residents, and 7 species, including the bald eagle, are winter residents. The other birds observed in December and February are summer residents that stayed late (mountain bluebird, chipping sparrow, rufous-sided towhee), summer residents that arrived early (Canada goose, cage sparrow), year-round visitors (Brewer's blackbird, mallard), and possibly a permanent resident (cañon wren).

The species variety in February was more evenly distributed: 18 in the riparian habitat, 14 in the juniper and in shadscale habitats; and 11 in the greasewood habitat. The total number of individuals recorded on transect walks was 342 in December, down from 559 in October. The total number of individuals recorded in February was 896. In the sampling the year before in December 1974 and February 1975, 89 and 166 individuals, respectively, were recorded. The year 1975 was a good year for the birds, as evidenced by the many birds wintering on the tracts. The large number of individuals (896) recorded in February 1976 was composed of passerines, especially the large flocks of rosy finches and horned larks, which moved throughout the tracts, and dark-eyed juncos and tree sparrows, which concentrated in riparian habitat.

Eight species of mammals were recorded on the tracts in December, and nine species were recorded in February. Both figures include domestic sheep and do not include the small rodents that were active (tracks in fresh snow) but not sampled because of high mortality in the traps. The number of resident species (sheep excluded) varied in the four habitats. In December four species were recorded in riparian, juniper, and greasewood, and three were recorded in shadscale. In February six species were recorded in the riparian and three were recorded in the other three habitats, again excluding sheep.

A total of 439 individuals were recorded on transect walks in December, 328 of which were sheep. The number of wild species recorded (111) is comparable to the number recorded in August and October (110 and 112 respectively, exclusive of domestic livestock). The total number of individuals recorded in February transect walks was 1936 (excluding livestock, 63). This decrease in resident mammals is due to a combination of factors. First, overwinter mortality takes its

toll through a combination of weather conditions, home-site selection, predation, etc. Second, some mammals, like chipmunks and prairie dogs, cannot be observed because their above-ground activities cease in winter. (Other mammals, like beaver and muskrat are more active.) Third, mule deer leave the tracts during winter. Fourth, during winter, mammals like the whitetail squirrel are less active in the morning and evening, when the transects are walked. Fifth, rabbit hunting on and around the tracts was very successful.

b. Large Mammals

Table IV-1 is a summary of the number of deer and their locations during the trend count. A very obvious trend for deer was their movement to higher elevations to escape the cold. The first extremely cold weather began December 12 and 13. Fog was prevalent, with a cold-air inversion that caused temperature differences of -7°C to -4°C (20°F to 25°F) between the lower (river bottom) and higher (upland) areas of the project area. At the time of the count (December 15 and 16), deer were numerous in the riparian area around Hells Hole Canyon but became increasingly scarce downstream. Below Ignacio, all but six of the deer located were in the broken upland and juniper areas above the riparian area. In numerous instances deer tracks found at the river led directly to higher elevations away from the river, where the deer could be found wintering. Additionally, collared deer .02 was observed December 16 at Station S-13 and again December 17 at Station A-11. During this period, an additional deer (male fawn), apparently a fawn of deer .02, was collared at Station A-11.

TABLE IV-1

DECEMBER TREND COUNT

Number	Location
68	Hells Hole (uplands and river)
8	Station A-7 to Ignacio
12	Evacuation Pipeline (river)
20	Igancio to Station A-3
16	Station A-3 to Asphalt Wash
10	Evacuation Creek
12	Station A-11
6	Station X-4
152	Total Area

Total Deer:	152
Total Area:	26,018 acres; 40.7 sq mi
Density:	.0058 deer/acre 171.1 acres/deer 3.73 deer/sq mi

Subsequent field investigations in December, January, and February also indicate that large numbers of deer were wintering in the high elevation areas located during the December count. It is apparent that deer remain in the riparian areas during fall until the onset of cold-air inversions, when the deer migrate to higher elevations of 1620 m to 1770 m (5300 ft to 5800 ft) in the uplands surrounding the river. The deer concentrate in several areas and remain through the coldest part of the winter, as evidenced by the deer collared in mid-December in one of these winter areas and observed again in February approximately 220 m (720 ft) from the point of capture.

Both investigations confirm that there are summer and winter migration patterns in the project area. The mule deer in this particular area spend the late spring, summer, and fall in low elevations along the river and migrate to higher elevations to the north and to the south in winter to escape the severe cold along the river. No preference is demonstrated for these wintering areas to the north and south of the river. This trend, from low to higher elevations, is the reverse of normal mule-deer migration patterns.

With the more moderate weather in late February at least some of the deer began moving back toward the river. Deer .05 and .06, both located in the upper stretches of the river the previous fall, reappeared in the same areas. Along the lower stretches of the river, however, deer remained at higher elevations.

Only three coyotes were located--two at Station A-11 and one near Station X-2. The few coyotes found after 12 hours or low-speed helicopter flying indicates a very low population level at this time of year.

Soon after the coyote helicopter count the Bureau of Sport Fisheries and Wildlife conducted an aerial gunning of coyotes in the area, killing three coyotes. Several weeks later, when sheep were brought to the project area for the winter, another gunning took place in which ten coyotes were killed. Although many conditions (weather, snow cover, etc.) govern the success of aerial gunning, the evidence indicates that coyotes move onto the project area when the sheep herds are present.

c. Raptors

A list of raptors (numbers and species) located during the survey is included below.

WINTER RAPTOR SURVEY

9 mature golden eagles
2 immature golden eagles
2 mature bald eagles
1 immature bald eagle
2 marsh hawks
1 prairie falcon
1 rough-legged hawk

3. TERRESTRIAL INVERTEBRATES

No new data are available for this quarter.

4. AQUATIC BIOLOGY

The modified periphyton samplers (see the fourth and fifth quarterly reports) worked successfully during November. The samples were removed and sent to the USGS for analyses. Two strips were analyzed from each station, and the results were reported as averages of the two (Table IV-2).

The most significant information from these data were the biomass-to-pigment ratio and milligrams of chlorophyll per square meter. The biomass-to-pigment ratios indicate the relationship between autotrophic (producers) and heterotrophic (bacteria, fungi, etc.) communities. The high ratios found in the samples indicate a high degree of heterotrophism.

The four-week accumulations of chlorophyll were quite low. The USGS categorizes streams producing less than 2 mg/m^2 of chlorophyll as unproductive, those producing about 10 mg/m^2 as average, and those producing over 12 mg/m^2 as very productive. Note, however, that these samples were taken in November, when days were short and water temperatures near freezing.

Most algae produce chlorophyll a, but only green algae and euglenids produce chlorophyll b. In these samples, the chlorophyll a was produced by diatoms. One sample strip from each sampler was examined at the Bonanza laboratory to determine community composition and to conduct cell counts. There does not appear to be a well-defined relationship between cell counts and chlorophyll accumulation.

Invertebrates were sampled at an open spot immediately above the Bonanza bridge. Sampling was limited because of hazardous conditions. The invertebrate community was composed of mostly *Oemopteryz fosketti* and *Isogenoides frontalis* (stoneflies), *Rhithrogena undulata* (mayfly), *Hydropsyche* sp. (caddisfly), and empidids (Diptera). Although the samples were qualitative, the density appeared to be quite low, approximately 25 organisms per screen sample.

5. MICROBIOLOGY

This report includes the results of samples collected in 1975 and not submitted in previous quarterly reports.

TABLE IV-2

PERIPHYTON DATA

Station F-6 (Evacuation Creek)

BIOMAS(PERI)ASH G/M2	4.3	BIOMASS PIGMNT RATIO	93
BIOMAS(PERI)DRY G/M2	4.5	CHLRPHYL(PER)A MG/M2	1.7
		CHLRPHYL(PER)B MG/M2	0.1

Cell Count (VTN)
318,000 cells/cm^2

Station F-3 (White River near Bonanza Bridge)

BIOMAS(PERI)ASH G/M2	0.1	BIOMASS PIGMNT RATIO	1400
BIOMAS(PERI)DRY G/M2	0.4	CHLRPHYL(PER)A MG/M2	0.2
		CHLRPHYL(PER)B MG/M2	0.0

Cell Count (VTN)
2400 cells/cm^2

Station F-4 (White River near Southam Canyon)

BIOMAS(PERI)ASH G/M2	0.0	BIOMASS PIGMNT RATIO	0.0
BIOMAS(PERI)DRY G/M2	0.0	CHLRPHYL(PER)A MG/M2	0.0
		CHLRPHYL(PER)B MG/M2	0.0

Station S-11 (White River below Asphalt Wash)

BIOMAS(PERI)ASH G/M2	24	BIOMASS PIGMNT RATIO	680
BIOMAS(PERI)DRY G/M2	24	CHLRPHYL(PER)A MG/M2	0.7
		CHLRPHYL(PER)B MG/M2	0.0

Cell Count (VTN)
67,000 cells/cm^2

a. Water Potential

Data pertaining to water potential was used to determine soil conditions. The data from each site were plotted (water potential versus the time of year) in order to discern seasonal variations (Figure IV-1). The three conditions determined can be thought of as low stress (good to adequate soil moisture environment), intermediate stress (adequate to poor moisture soil environment), and high stress (very poor soil moisture environment) in reference to the microbial population. These conditions--termed 1, 2, and 3, respectively--were defined as follows:

Condition 1 = 0-50 (-bars water tension)
Condition 2 = 50-150 (-bars water tension)
Condition 3 = <150 (-bars water tension)

Site 58C-1, 58C-2, and 58C-3 shown on Figure IV-2 are taken from increasing depths, respectively. This figure shows that high moisture-stress conditions occur between early August and October. It was noted that stress conditions differed for soils under canopies and soils in interspaces.

b. Nitrification

Nitrification data are summarized in Table IV-3. Soils 39, 50J-L, 50J-I, and 55 showed a high potential for oxidation of available NH_4^+ to nitrate and nitrite. Soils 58C, 58I, and 58L showed a negligible conversion of ammonium ion to the oxidized forms for the same sample date. This same pattern was reflected in the September 1975 data from the same sites.

c. ATP Concentration

The ATP values recorded over the entire 1975 sampling period are included in Table IV-4. The highest values occurred between late May and early August, with a sharp decline at all sites in summer and a subsequent increase throughout the fall.

d. Total Ammonium Nitrogen

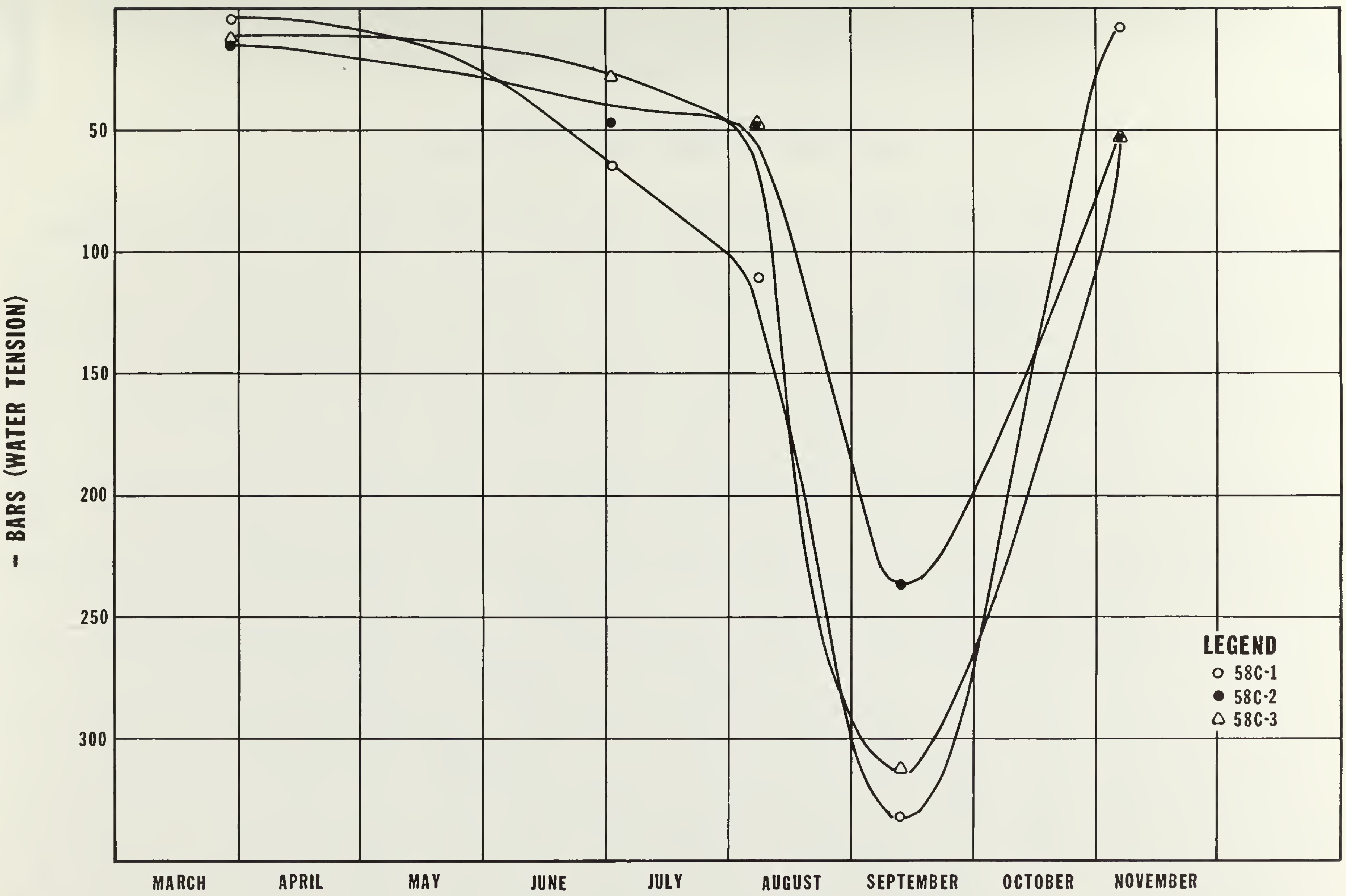
Data regarding the concentration of ammonium nitrogen, expressed in ug N/g dry soil, are given on Table IV-5.

TABLE IV-3

NITRIFICATION POTENTIAL
6 November, 1975
μg N/g dry soil

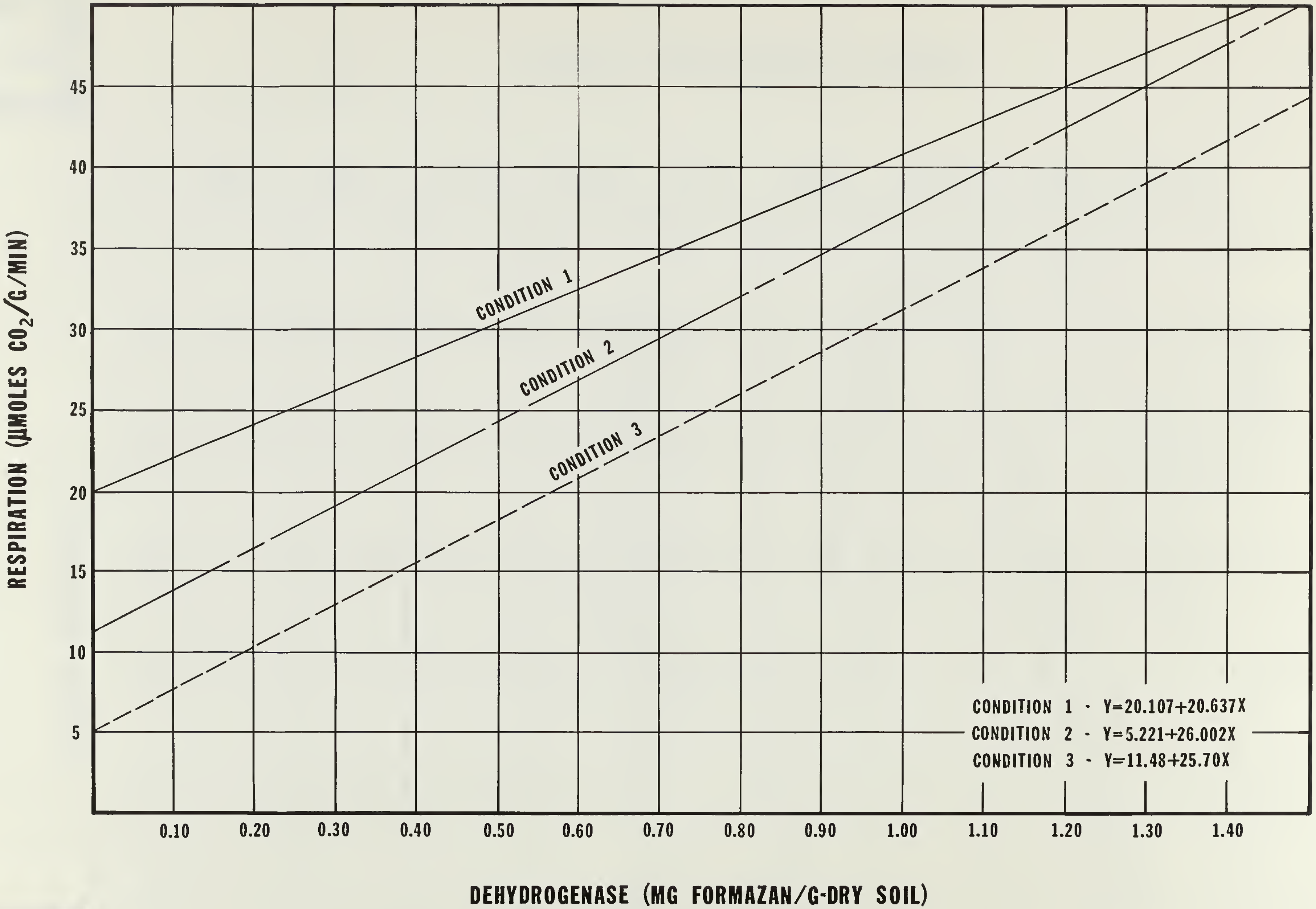
Sample	NH_4^+	$NO_2^- + NO_3^-$	NO_2^-
39	0	168.45	6.13
50J-C	0	4.44	0.11
50J-I	0	32.55	0.23
55	95.28	31.76	>0.12
58L	154.31	0	0
58C	115.60	1.12	0
58I	184.45	0	0

NOTE: Since concentration of NO_2^- is negligible it can be assumed when analyzing for NO_2 + NO_3 that most N is in the form of NO_3. (Surface samples only)



SEASONAL STRESS VARIATIONS AT SITE 58C

FIGURE IV-1



RELATIONSHIP OF BEST FIT LINES

FIGURE IV-2

TABLE IV-4

ATP CONCENTRATION - 1975
µg/g dry soil

Sample	28 March	25 April	16 May	27 May	2 July
39-1	1.8×10^{-2}	3.9×10^{-2}	3.6×10^{-2}	3.8×10^{-2}	1.2×10^{-2}
39-2	4.6×10^{-3}	---	---	5.0×10^{-3}	8.7×10^{-3}
39-3	4.4×10^{-3}	---	---	0	8.1×10^{-3}
50J-C-L	---	---	---	---	---
50J-C-1	1.6×10^{-2}	2.9×10^{-2}	3.2×10^{-2}	5.8×10^{-2}	2.7×10^{-2}
50J-C-2	2.8×10^{-3}	---	---	---	---
50J-I-1	3.3×10^{-3}	4.2×10^{-2}	3.3×10^{-2}	9.3×10^{-2}	1.6×10^{-2}
50J-I-2	2.2×10^{-2}	---	---	---	---
55R-1	1.8×10^{-2}	6.0×10^{-2}	4.5×10^{-2}	2.7×10^{-2}	2.0×10^{-2}
55R-2	1.3×10^{-2}	---	---	1.2×10^{-2}	8.9×10^{-3}
55R-3	5.7×10^{-3}	---	---	1.8×10^{-2}	6.9×10^{-3}
58C-1	---	---	---	---	6.5×10^{-3}
58C-2	1.3×10^{-2}	---	---	---	1.9×10^{-3}
58C-3	1.5×10^{-2}	---	---	---	7.2×10^{-3}
58I-1	4.6×10^{-2}	3.4×10^{-2}	4.0×10^{-2}	6.9×10^{-2}	5.5×10^{-3}
58I-2	2.1×10^{-2}	---	---	2.3×10^{-2}	5.3×10^{-3}
58I-3	1.3×10^{-2}	---	---	2.3×10^{-2}	7.0×10^{-3}

TABLE IV-4 (Cont.)

Sample	8 August	12 Sept.	13 Oct.	6 Nov.
39-1	3.2×10^{-2}	1.1×10^{-2}	3.4×10^{-2}	3.2×10^{-2}
39-2	---	---	---	---
39-3	---	---	---	---
50J-C-L	---	---	---	---
50J-C-1	1.8×10^{-2}	3.6×10^{-2}	5.9×10^{-2}	1.1×10^{-1}
50J-C-2	---	---	---	---
50J-I-1	2.6×10^{-2}	1.4×10^{-2}	6.0×10^{-2}	5.3×10^{-2}
50J-I-2	---	---	---	---
55R-1	3.6×10^{-2}	1.0×10^{-2}	---	3.2×10^{-2}
55R-2	---	8.4×10^{-3}	---	---
55R-3	---	3.5×10^{-3}	---	---
58C-1	8.2×10^{-3}	1.1×10^{-2}	---	5.4×10^{-2}
58C-2	---	3.0×10^{-3}	---	---
58C-3	---	5.9×10^{-3}	---	---
58I-1	4.8×10^{-3}	1.2×10^{-2}	5.8×10^{-2}	3.0×10^{-2}
58I-2	---	3.0×10^{-3}	---	---
58I-3	---	3.2×10^{-3}	---	---

TABLE IV-5

TOTAL AMMONIUM NITROGEN
(μg N/g dry soil)

Sample	8 Aug. 1975	12 Sept. 1975	13 Oct. 1975	16 May 1975
39-1	30.90	31.61	25.01	54.20
39-2	29.80	24.05	11.30	32.99
39-3	19.90	22.10	11.45	28.23
50J-I-1	75.80	85.66	105.80	90.00
50J-I-2	99.60	---	---	89.56
50J-L	---	33.56	---	---
50J-C-1	93.20	62.92	104.23	80.79
50J-C-2	111.30	---	---	---
55R-1	47.00	15.26	62.70	54.39
55R-2	14.65	20.24	---	22.24
55R-3	13.30	41.95	21.52	9.88
58I-1	18.70	26.27	22.32	30.87
58I-2	14.80	20.90	14.58	21.94
58I-3	11.00	11.96	8.18	15.59
58C-1	61.20	51.95	33.00	---
58C-2	32.90	38.97	16.19	---
58C-3	31.60	59.09	15.29	---

Samples are being analyzed for fixed and exchangeable ammonium. These analyses will provide a much broader base for determining the status of ammonium nitrogen in the soils.

Overall, the total NH_4^+ fluctuated over the fall, depending on the site. The values at site 39 generally decreased from August to September at all depths, whereas the values at site 50J-1 increased. The values decreased with depth and were generally higher under the canopy than in the interspaces.

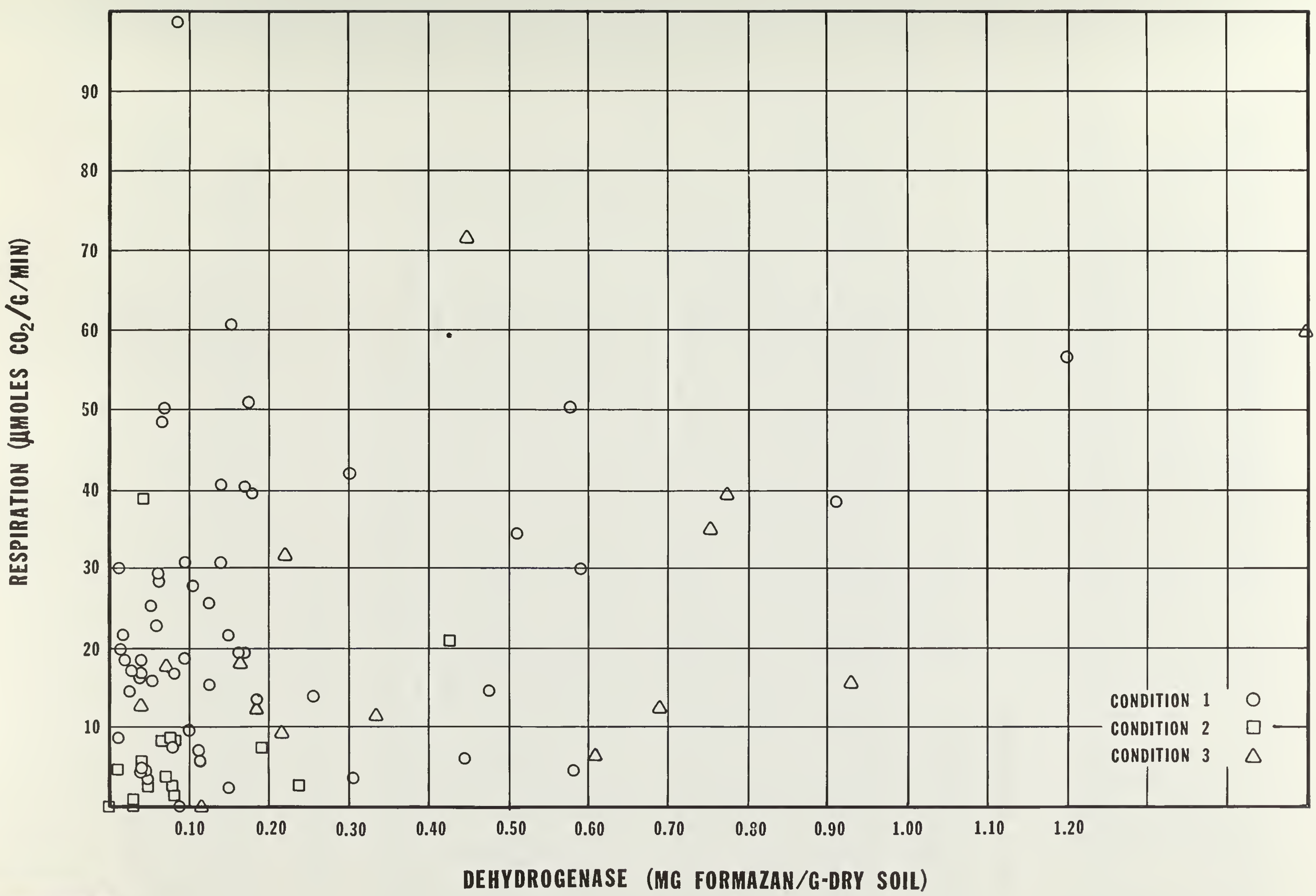
e. Statistical Analysis

Means, standard deviations, regression analyses, and equations for best-fit curves were calculated for each indicator. The regression values were low, as expected, because soil-condition assessments were based on relatively broad limits of water tension. The best-fit curve equations show, however, that definite variations in activities do exist, according to conditions. These data are given on figures IV-2 and IV-3, which indicate the divergence of best-fit curves and the corresponding dispersal of points into conditional dependent areas. Condition-1 points are clustered around an area defined by relatively low dehydrogenase activity and moderate-to-high respiration. Condition-2 points cluster around an area of low values for both variables. Condition-3 points tend to spread out along the x (or dehydrogenase variable) axis while ranging from low to moderate respiration.

To validate this relationship, that is, to determine to what degree the points could be expected to fall within these areas, the variations were further analyzed, specifically by the F test. To allow for variance from the mean within the boundaries of each condition, analysis and adjusted analysis were run for each variable, i.e., respiration (2) and dehydrogenase (1). Inference of good reliability in the relationships and data observed can be made from the F values and confidence limits.

Physical and biochemical processes that are the basis for the relationships found are being considered to help explain the observed phenomena. Supportive ATP data was incorporated into the program.

Information obtained from correlation and regression analyses indicate that a negative correlation exists between ATP values and respiration for condition 1, whereas positive correlations for conditions 2 and 3 are evident. Conversely, a positive correlation exists between ATP values and dehydrogenase for condition 1, and a negative correlation for



RELATIONSHIPS OF ACTIVITIES BY CONDITION

FIGURE IV-3

conditions 2 and 3 are found. These relationships are given on Figures IV-4 and IV-5. Only surface samples were used in these analyses. Statistical treatment of current data indicates differing relationships of biological activity in the soil, depending on environmental conditions. There is evidence that ATP is an inhibitor of metabolic activities in such soils, but additional data is necessary before definitive conclusions can be drawn. These relationships can be described more definitely after the 1976 data are incorporated.

C. WORK SCHEDULED

1. VEGETATION

Mr. Jerry Barker, of USU, who is also conducting research on revegetation of processed oil shale, will take phenological measurements during the 1976 plant-growing season. The dates for this observation--approximately March 15, May 15, July 15, September 15, and November 15--generally correspond with the end of winter dormancy, peak growth of annual species, summer growth of perennials, fall maturity of perennials, and fall seed dispersal-beginning of dormancy, respectively. Soil moisture, soil temperature, and soil surface temperature will be monitored on these dates.

A vegetation analysis planned for June 1976 will include a larger number of plots than in previous monitoring periods. The number of plots sampled will be based on data from previous sampling periods. The stem growth of 100 sagebrush (*Artemisia tridentata*) plants will be measured in each of the vegetation types. Stem growth for the 1975 season will be measured in spring 1976 before new growth starts, and growth for 1976 will be measured in late September. These measurements are expected to be relatively uniform and indicative of site favorability. They may be used as an index of environmental conditions affecting plant growth.

2. TERRESTRIAL VERTEBRATES

The April sampling to be conducted during the next quarter will include the transects for birds, mammals, and reptiles, rodent transect trapping, and the large trap grids. In reference to the rodent trapping, when rodent trap mortality exceeds 10 percent of a night's catch, trapping is suspended for a night or stopped completely, depending upon conditions.

Large-mammal monitoring (telemetry) will continue as scheduled, as will raptor and waterfowl studies.

3. TERRESTRIAL INVERTEBRATES

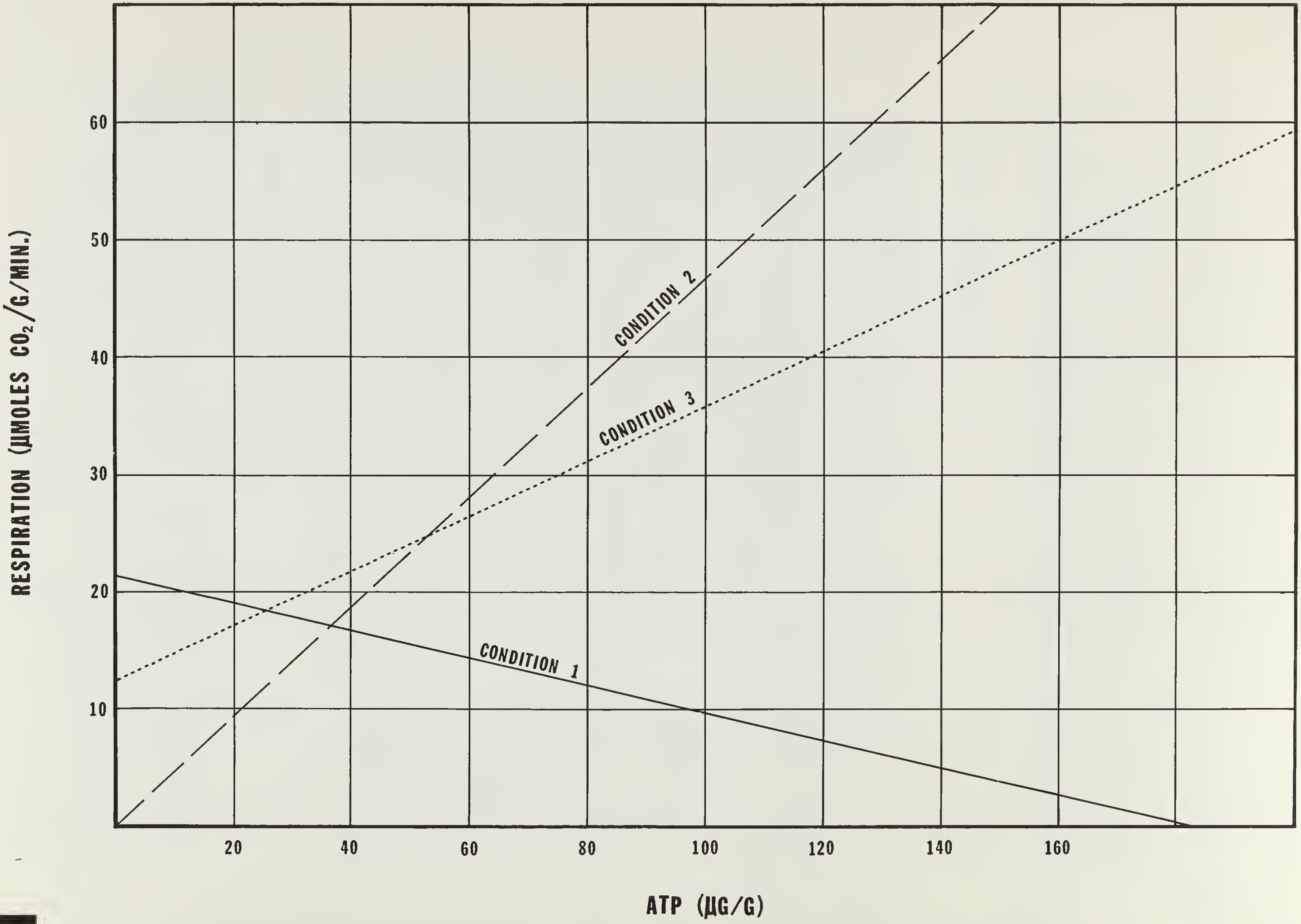
Determinations will continue for organisms collected in the past. Sampling will resume in May.

4. AQUATIC BIOLOGY

A field sampling expedition is tentatively scheduled to begin March 15. The sampling will be as complete as permitted by stream and weather conditions. Sampling will be stratified to a greater extent in an effort to increase confidence levels. Periphyton samplers will be deployed as soon as the streams are free of ice. A fisheries study with seines and trammel nets will be attempted in April 1976.

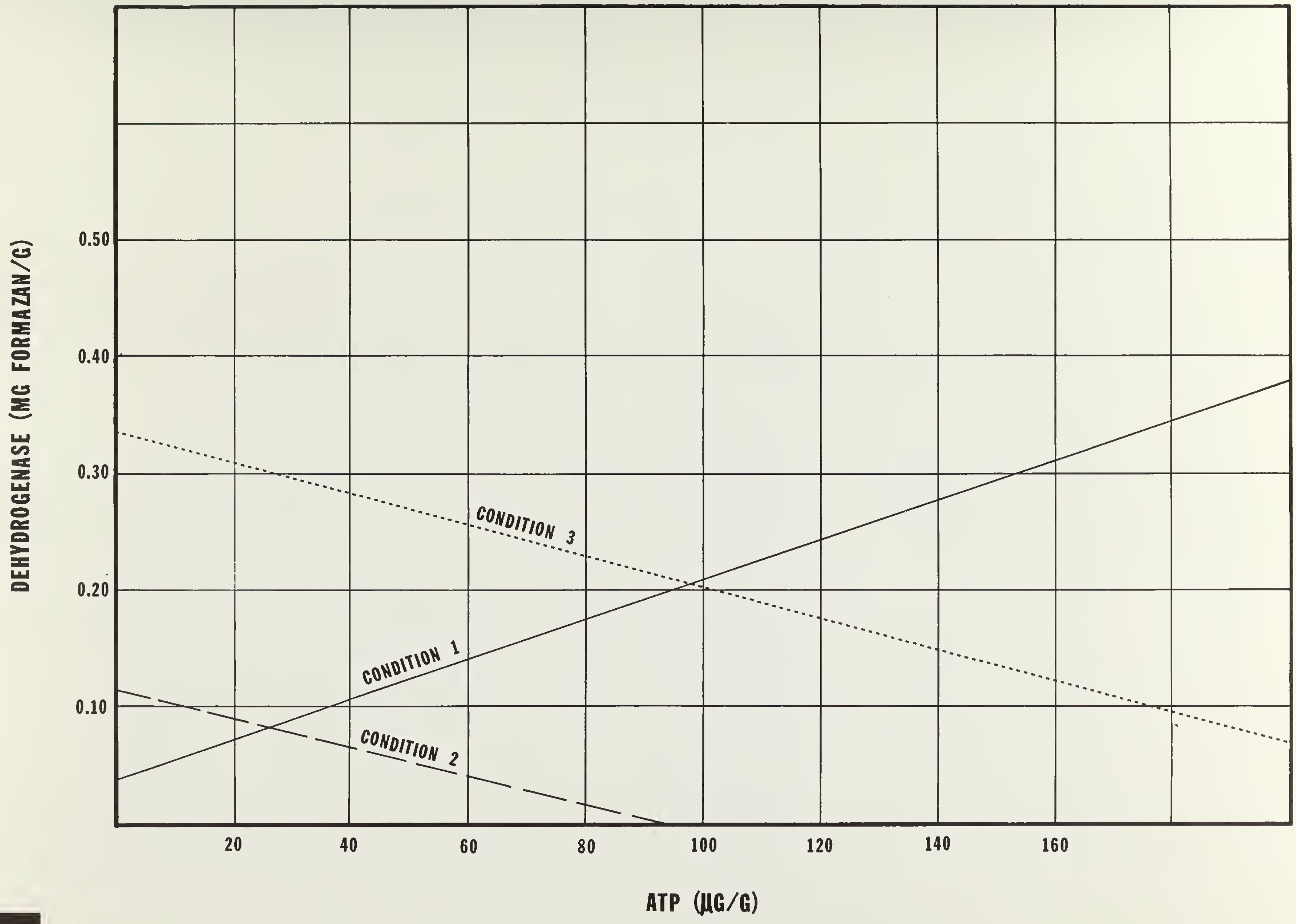
5. MICROBIOLOGY

Laboratory analysis will continue and samples will be collected during the spring quarter.



CORRELATIONS PER CONDITION -
ATP VERSUS RESPIRATION

FIGURE IV-4



CORRELATIONS PER CONDITION -
ATP VERSUS DEHYDROGENASE

FIGURE IV-5

V. GEOLOGY AND SOILS

A. WORK COMPLETED

No work was done this quarter in either the soils or the geology program.

B. DATA SUMMARY

Not applicable.

C. WORK SCHEDULED

The soils trace-element program will be initiated this spring as outlined in the revised Conditions of Approval, effective February 23, 1976. As reported in previous quarterly reports and the First Year Environmental Baseline Report, the geology program is complete and will not be reported in future quarterly reports.

VI. HISTORIC AND SCIENTIFIC RESOURCES

A. WORK COMPLETED

A potential paleontological site was inspected January 23, 1976. A survey party from Uinta Engineering, Vernal, Utah, found what they thought to be fossil bone specimens in an area along the proposed road to the processing plant on Tract U-b. The paleontological subconsultant, Dr. Wade Miller, of BYU, found them to be petrified wood of no significance. The site was also visually inspected and no significant fossils were found.

B. DATA SUMMARY

Not applicable.

C. WORK SCHEDULED

The historic and scientific resources program is complete and will not be reported in future quarterly reports unless new findings are reported.

VII. REVEGETATION STUDIES FOR DISTURBED AREAS AND PROCESSED SHALE DISPOSAL SITES

A. WORK COMPLETED

As discussed in Quarterly Report No. 5, the White River Shale Project has contracted the Utah State University Agricultural Experiment Station to collect the data necessary to develop a program for revegetating processed-shale sites and disturbed areas with native plant species requiring minimal maintenance from the immediate region. The following facts or conditions are considered in the general scope of the research program:

a. Plants used in rehabilitating disturbed areas and processed-shale sites must be adapted for persistence under existing conditions.

b. Water is scarce in the oil-shale area, and any use of it for revegetation must be minimal.

c. Salinity in the processed shale is a serious problem because it inhibits plant growth and because saline leachates could enter the drainage system.

d. Surface dust may be a problem.

e. Revegetation of salt desert shrub ecosystems by direct seeding with exotic grasses has no record of success.

There were a number of important accomplishments from July 1 to December 31, 1975. During this period the results of some of the research have become available, studies have been planned and initiated, and consulting services have been provided for the detailed development plan.

A field-study site was established in Section 6, T10S, R25E north of the White River, because the area is representative of most of the environments found on the tracts. The 2.4-hectare (6-acre) site was fenced and prepared for the studies needed. Several experiments have been conducted there since the first experiment in mid-summer 1975.

A literature review of published information relative to revegetation of processed oil shale in a salt desert shrub vegetation type is in the final draft stage. This review has been delayed by additions and the need to screen and assess new reports that may be relevant to revegetation with native plant species and to natural precipitation.

The results from the transplanting of over 1,000 bare-root shrub seedlings and container-grown plants on four disturbed sites indicate that transplanting is the best method of ensuring plant establishment. Although tentative until winter survival is assessed, the data indicate that transplanting success rates as high as 90 percent can be expected with big sagebrush and black sagebrush on sites of average severity; the rate may fall below 50 percent for more severe sites. Because of their deep roots, greasewood bare-root seedlings may not be transplanted with complete success, as indicated by an average survival of 49 percent on average sites and 0 percent on harsh sites. Nearly 100 percent of the container-grown four-wing saltbush transplants survived on all sites, indicating the desirability of using container-grown stock, particularly on harsh sites.

Seeds from 55 diverse species native to the tracts were collected during summer and fall. Each species was observed for a record of its optimum time and phenological stage for collection. The methodologies and special equipment required for cleaning were noted so that recommendations and standard procedures could be prepared to facilitate the use of these seeds in revegetation. The seeds are now being cleaned and prepared.

Germination, a simple process in many native species, has been difficult in the *Atriplex* species on the tracts. Because it is the dominant species in the area and valuable as feed for wildlife and livestock, published information on the subject is being reviewed and a series of experiments are planned.

An understanding of how the roots of native species adjust to processed shale is crucial in developing guidelines for revegetation. A preliminary rooting study showed that seedling roots of four-wing saltbush (*Atriplex canescens*), shadscale (*A. confertifolia*), and Russian wildrye (*Elymus junceus*) grew from a soil mass into processed shale, whereas sand dropseed (*Sporobolus cryptandrus*) and Indian ricegrass (*Oryzopsis hymenoides*) failed to penetrate the shale. Researchers working on the Colony Development revegetation plots observed that rooting habits changed when growing from soil into shale. Three experiments have been designed to investigate further the underlying physiological processes.

Effective surface-stabilizing materials are needed to implement revegetation. Of the six materials applied at three different rates at the field site, polyvinyl acetate (Aerospray-70 and Soil Seal) was the most satisfactory in preventing particle movement and creating a surface

crust. The results of the initial experiment were observed for four months; additional observation time is needed to determine the effectiveness of these materials. Additional studies will be conducted to determine the optimum slope distances and water-harvesting abilities of the polyvinyl acetate.

USU Foundation has communicated extensively with organizations requesting information concerning the revegetation of harsh sites. USU Foundation personnel have participated in three planning meetings with Bechtel Corporation, a review with the Western Energy and Land Use Team (WELUT), two field visits with representatives of the Area Oil Shale Supervisor's Office, and have responded to numerous telephone calls. In addition, two papers from earlier work relevant to this project were published: a paper was presented at the U. S. Forest Service Shrub Workshop, and a paper on disturbed-site rehabilitation was prepared and accepted for presentation at the February 1976 meetings of the Society for Range Management in Omaha, Nebraska.

B. DATA SUMMARY

See *Quarterly Report No. 6 Field Data*.

C. WORK SCHEDULED

a. Literature Review

The completion of the literature review was delayed so that current published information could be included. The document is expected to be published soon as a report of the Utah State Agricultural Experiment Station.

A spring planting on disturbed sites will take place in late March or early April 1976, depending on the weather. Seeds have been collected mainly from the dominant vegetation for use in subsequent studies. During the next summer and fall seeds will be collected from the less dominant vegetation.

Seeds of various size classes and seed fill will be germinated in germination dishes and in field plantings. The seeds will be observed and measured to determine the effect of seed quality on seedling vigor.

The germination requirements of native species selected for use in revegetation plans will be studied so that a criteria for routine propagation can be determined.

Experiments are continuing with vegetative cuttings and various plant hormone concentrations to improve the percentage of cuttings that will root to form new plants.

b. Soil Surface Stabilizing Materials

The persistence of the polyvinyl acetates under cold weather conditions will be evaluated in Spring 1976. Soil moisture at a depth of less than 15 cm (6 in.) will be measured in spring 1976.

The 1975 study raised the following questions: Proportionately, how much runoff can be obtained by surface stabilizing treatments, how much distance can water be expected to run, what combination of treatment sequences is effective for the Aerospray-70 polyvinyl acetate, can straight-run Paraho process shale be surface-treated without screening as was done in the 1975 trial, and are depressions or basins as effective as slopes in harvesting runoff?

To answer these questions and to gain additional experience in working with the Paraho processed shale, a series of two sizes of basins and slopes top-dressed with 5 cm (2 in.) of Paraho processed shale was established at the Section 6 research site in late fall. Because of delays in obtaining sufficient shale and the susceptibility of the polyvinyl acetate to freezing temperatures before it sets up, the plots will be completed in the spring and tested for water-shedding characteristics by simulated rainfall.

At present the plot layout includes 20 basins 90 cm in diameter and 20 basins 150 cm in diameter, and 20 rectangular plots 1 m x 2 m and 20 plots 1 m x 3 m. The rectangular plots are on a 1:5 slope. Each plot and basin is equipped with a 4-liter collecting container for catching and measuring runoff. Surface-stabilizing treatments planned for spring application include four replications of five treatments of Aerospray-70 at (25 and 50 gallons/acre) rates applied in single and split applications. These rates may change, depending upon the spring observations of materials applied in 1975.

Additional surface-stabilizing materials have been obtained and will be tested on small plots at the research site.

c. Growth of Plants in Processed Shale

Wood-frame boxes 2 m square and 30 cm deep were buried in the soil at the experimental site in Section 6. These were divided in half and one side was filled with spent shale and the other side was filled with 15 cm of spent shale covered with 15 cm of soil. This spring the boxes will be planted with container-grown stock of several species. The boxes were put out this fall for greater stabilization of the soil material and spent shale through overwintering. Further details will be included in the next report.

VIII. GEOLOGIC EXPLORATION PROGRAM

A. WORK COMPLETED

The results of the 30-day creep tests on core samples are not available at this time. The results of heavy-metals tests are included in the sixth quarterly report field data.

The White River Shale Project and Cleveland Cliffs Iron Company conducted meetings with the AOSS for approval of the extended exploration drilling program. Sites were located and surveyed on the tracts for five additional X-holes consisting of two slant holes and three vertical holes.

B. DATA SUMMARY

Not applicable.

C. WORK SCHEDULED

The extended exploration drilling program will begin this coming quarter, with completion expected in early mid-summer.

DATE LOANED	BORROWER